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BULLETIN NO. 3

OF THE

ILLINOIS STATE MUSEUM

OF

NATURAL HISTORY.

DESCRIPTION OF SOME NEW SPECIES OF INVERTEBRATES FROM THE PALAEOZOIC ROCKS OF ILLINOIS AND ADJACENT STATES

BY S. A. MILLER AND WM. F. E. GURLEY.

SPRINGFIELD, ILLINOIS,
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SUBKINGDOM ECHINODERMATA.

CLASS ECHINIDA.

ORDER PERISCHOECHINIDA.

FAMILY PALAECHINIDÆ.

MELONITES INDIANENSIS, n. sp.

Plate I, Fig. 1, apical view.

Our specimen is injured, in a few places, though it is not easy to trace the outlines of the plates in the ambulacral depressions, and hence they are not distinguished in the illustration. The central basal part is destroyed and the oral plates are gone.

The form is strikingly melon-like, notwithstanding the depressions at the poles. The vertical height is two and fifteen-hundredths inches, and the transverse diameter is two and sixty-five-hundredths inches. The surface of the plates is covered with tubercles that formed the bases of spines. And some of the spines may be seen scattered over parts of the ambulacral depressions. The spines are minute, elongate, tapering, cylindrical in section, swollen a little at the basal extremity, and about one-tenth of an inch in length.

The interambulacral areas are lance-elliptical in outline, abruptly elevated from the ambulacral depressions, sharply rounded at the apical pole, more gently rounded toward the middle, while the middle part is only slightly convex. There are six ranges of plates at the middle part, a little higher only five, a little higher only four, and then there are only three, which grow smaller and terminate each interambulacral area by abutting a genital plate. There are from twenty to thirty tubercles on the larger plates.

Ambulacral areas as wide in the middle part, and wider toward the poles than the interambulacral areas, and separated in each ambulacral field the entire length by a sharply defined ridge elevated as high as the interambulacral areas. The plates are smaller and more irregular in the ambulacral depressions than elsewhere. The ambulacral pores are circular, two in each plate, and form four irregular ranges of pairs in each depression. When the two depressions, in each ambulacral area, unite near the ocular plate there are five or six rows of pores. The small plates are pierced with the ambulacral pores until they actually abut upon the little ocular plates.

Three pores are clearly distinguishable, in some of the genital plates, with an ordinary magnifier, and there are some evidences of other pores that have been closed or filled up. There are no pores in the ocular plates. The plates abutting the oral opening are angular and preserve the articulating edges of the oral plates.

Found in the St. Louis Group, at Greenville, Harrison county, Indiana, and now in the collection of Wm. F. E. Gurley.

OLIGOPORUS BLAIRI, n. sp.

Plate I, Fig. 2, the upper part of a specimen, somewhat crushed, and preserving none of the apical plates; Fig. 6, a smaller specimen, crushed so as to show only part of the ambulacral pores; Plate II, Fig. 7, the middle part of a much larger and flattened specimen.

The three specimens enable us to ascertain most of the external characters of this species, excepting the apical and basal plates, none of which are preserved. If they all belong to the same species, as we think, then they show great differences in the size of the plates and in the number longitudinally, without increase in the number of ranges, in either the ambulacral or interambulacral areas. In other words, if the three specimens belong to the same species, the plates increase, in size, with the growth, by accretion laterally, without intercalation of plates, but increase longitudinally by the intercalation of plates, and very little by accretion. We would not be understood as affirm-ing positively that this is the law governing the growth of this species, for if so, it would, probably, be the law in the growth of all species in this genus, and also in the family. We have not enough evidence in the three specimens before us, injured as they are, to positively affirm that they belong to the same species, but we think the weight of the evidence is in that direction, and hence we suggest the probability of the method of growth, the correctness of which will be determined by the examination of other specimens.

The interambulacral areas are lance-elliptical, in outline, moderately and evenly convex from one ambulacral depression to another. There are six ranges of plates at the middle part. The plates where well preserved, are covered with tubercles that appear to have been the bases of spines, though none of the spines are preserved on our specimens.

The ambulacral areas are about half as wide, in the middle part, as the interambulacral areas, and of almost uniform width throughout their length, tapering very slowly as they approach the summit and ocular plates. They are separated in each ambulacral field, by a sharply defined ridge elevated higher than the interambulacral areas. The plates are short and small in the ambulacral depressions and each one is pierced with a pair of circular pores. There are two ranges of these ambulacral pores in each depression throughout the length without the addition or intercalation of any plates or pores.

This species is distinguished from *O. danæ*, by the fact, that there are only six instead of eight ranges of plates in each interambulacral area.

Found in the Keokuk Group, at Boonville, Missouri, and now in the collection of both authors.

OLIGOPORUS BELLULUS, n. sp.

Plate I, Fig. 3, part of the upper half of a crushed specimen.

The surface of the plates, in our specimen, is coverd with tubercles, that formed the bases of spines, and some of the spines are scattered over parts of the ambulacral depressions. The spines are minute, elongated, tapering, cylindrical in section, swollen a little at the basal extremity, and about one-tenth of an inch in length. Oral, genital and ocular plates unknown. The form of our fragment indicates a length greater than the diameter, but as this is different from the form of all other species, it cannot be asserted any stronger than the appearance shown by the illustration.

The interambulacral areas are elongate-lance-elliptical, in outline, and moderately convex transversely. There are only four ranges of plates at the middle part, and they extend almost to the summit, where one terminates, and the other three continue to the genital plates.

The ambulacral areas are nearly as wide in the middle part, as the interambulacral areas, and they are of almost uniform width throughout their length, slowly tapering as they approach the summit and ocular plates. They are separated in each ambulacral field by a sharply defined ridge, elevated higher than the interambulacral areas. The plates are short and small in the ambulacral depressions and each one is pierced with a pair of circular pores. There are two ranges of these ambulacral pores in each depression throughout the length, without the addition or intercalation of any plates or pores.

This species is distinguished from all others by its general form and by having only four ranges of plates in the interambulacral areas.

Found in the Keokuk Group, at Boonville, Missouri, and now in the collection of Wm. F. E. Gurley.

OLIGOPORUS SULCATUS, n. sp.

Plate I., Fig. 4, basal view; Fig. 5, apical view.

Our specimen with the exception of the loss of a few plates is quite complete. It is silicified and not compressed in any direction, most of the sutures are more or less destroyed, but the outlines of some of the plates are preserved, and where the plates are broken wholly away, the cast shows the bases of the plates distinctly. The lower half has more of the plates broken away and shows the pores of the ambulacral areas better than the other half. The mouth, ocular, genital and anal plates are not preserved, with the exception of one ocular and two genital plates, that may be distinguished.

The form is strongly melon-like. The vertical height is two and two-tenths inches, and the transverse diameter two and six-tenths inches. The silicification destroyed the tubercles and all evidence of spines.

The interambulacral areas are somewhat lance-elliptical, in outline, abruptly elevated from the ambulacral depressions, sharply rounded at the apical pole, and broadly rounded near the basal extremity, and flattened on the outer face, throughout the whole length. There are seven ranges of plates at the middle part, including the two that dip down into the ambulacral depressions on the sides, or five occupy the flattened surface on top. One of the middle ranges is short, another soon gives way to the narrowing of the area, and while five reach near the basal extremity, only three extend toward the apical end to unite with a genital plate.

Ambulacral areas only half as wide, in the middle part, as the interambulacral areas, and of almost uniform width throughout their entire length, tapering only slightly as they approach the summit and ocular plates. They are separated in each ambulacral field by a sharply defined ridge, elevated as high or rather above the interambulacral areas. The plates are very small in the ambulacral depressions and each one is pierced with a pair of circular pores. There are two ranges of these ambulacral pores in each depression throughout the entire length, and, in the middle part, there seem to be additional pores, but their extent is not exactly determined.

This species will be readily distinguished from *Melonites indianensis*, by the flattened interambulacral areas, and from it and all other described species, in that genus, by the narrow ambulacral areas, with almost uniform width, and by the two ranges of pores in each depression. We do not know the plates that cover the summit or the base of either *Melonites* or *Oligoporus*. Notwithstanding, Prof. Hambach (Trans. St. Louis Acad. Sci. Vol. IV. p. 549) has examined over 500 specimens of *Melonites multiporus*, and described new species of *Melonites* and *Oligoporus*, these important plates remain unknown. It is wholly unnecessary to compare this species with any other in the genus, because it is not only from a different group of rocks, but it is widely different in form from all of them.

Found in the St. Louis Group, in Hardin county, Kentucky, and now in the private collection of Wm. F. E. Gurley.

CLASS CRINOIDEA.

ORDER PALAEOCRINOIDEA.

FAMILY ACTINOCRINIDÆ.

ACTINOCRINUS GIBSONI, n. sp.

Plate 2, fig. 1, dorsal, or opposite view from the azygous side.

Species very robust: column, calyx, and arms large. Our specimen is compressed, but evidently the calyx is quite as long as wide, deeply sculptured, plates thick, and interradial areas rather small. Proboscis unknown, but another specimen, probably belonging to this species, has a moderately long proboscis curved to one side toward the top, and is covered with tumid plates like an *Eretmocrinus.* Column composed of thicker and thinner plates, the former projecting beyond the latter.

Basals one half wider than high, very thick, contracted in the middle so as to leave an expanded rim projecting much beyond the column and widely gaping at the sutures in the rim, the excavation being almost triangular and extending nearly to the radial plates; upper part of the plates having three short, longitudinal ridges that fade away before reaching half the length of the plates.

First primary radials very large, nearly half as long as the calyx, one-third longer than wide, three hexagonal, two heptagonal; the surface is marked with a strong transverse tubercle in the middle part, from which the heptagonal plates have two radiating ridges extending to each of the adjoining basals and one toward each of the other adjoining plates; and the hexagonal plates have three ridges extending to the single abutting basal and one toward each of the other adjoining plates; each plate also bears a small, round tubercle above the transverse one. Second primary radials less than half the size of the first; hexagonal superior sloping sides shorter than the inferior; surface ornamented with a high pointed tubercle and a rounded radiating ridge directed toward each adjoining plate. Third primary radials smaller than the second; heptagonal, ornamented in the same way that the second are, and bearing upon each upper sloping side a single secondary radial. The secondary radials are quite small and thin, and each one bears three or more short tertiary radials before the arms become free. Most of the arms bifurcate almost immediately after becoming free, and again at irregular distances from the calyx. The ray on the left of the specimen illustrated preserves nine arms near the calyx, and probably the lower one bifurcated at the place at which it is broken off, and two of the arms are preserved above another division. The ray on the right of the illustration, though not so well preserved, appears to have had the same number of arms. The central ray, however, appears to have had only six arms, near the calyx, and only one of these is preserved far enough to show a second bifurcation. The probability is that a complete specimen would have from forty-six to fifty arms, near the calyx, and a number of bifurcations above. The arms are exceedingly long and of uniform size, each branch being about as large as the arm below the bifurcation. They are composed of a double series of very short interlocking plates bearing dense pinnules.

First regular interradial hexagonal smaller than a second primary radial, followed by two smaller plates in the second series, and three smaller ones in the third, that unite with the plates of the vault. Surface of the interradials ornamented the same as the second and third primary radials. Azygous plates unknown.

This species is remarkable in the number and structure of the arms, and the surface ornamentation of the calyx will also serve to distinguish it. Possibly this species belongs to *Eretmocrinus*, though the arms are those of *Actinocrinus*.

Named in honor of William Gibson, of Belpre, Kansas, to whom science is indebted for the discovery of many interesting fossils.

Found in the Keokuk Group, on Indian creek, near Crawfordsville, Indiana, and now in the collection of Wm. F. E. Gurley.

ACTINOCRINUS AUGUSTATUS, n. sp.

Plate XII, Figs. 8 ana 8 a, Vol. VIII, Geo. Sur. Ill., and described on page 97 of the same volume, as Actinocrinus lobatus, Hall.

Body large. Calyx somewhat obpyramidal, longer than wide; radial ridges moderately protuberant; interradial areas small, somewhat flattened and slightly depressed; plates thin; surface ornamented with low radial ridges, which commence on the first radial and extend to the tertiary radials, and with short radiating ridges from the center of each plate to each adjoining plate, while the interradials bear a central node with a low radiating ridge to each adjoining plate. Dome conical and slowly diminishing into a large ventral tube composed of tumid and strongly protuberant plates.

Basals three, pentagonal, about as large as the first radials, and forming a cup, half as high as wide, slightly constricted in the middle, so as to form a rounded rim, on the lower half, that projects a little beyond a rather large column; surface smooth, not sculptured.

First primary radials large, length and breadth subequal, hexagonal and heptagonal. Second primary radials about half as large as the first, hexagonal and having the superior sloping sides shorter than the inferior sloping sides, (Fig. 8 is not exactly correct, in this respect, the artist having followed an ink line instead of the suture). Third primary radials smaller than the second, heptagonal and bearing upon each upper sloping side a single secondary radial. Each secondary radial supports on each upper sloping side three or four tertiary radials, one of which in each series is axillary on the third plate, from which two arms arise, which gives six arms to each radial series, so far as they are preserved in the two specimens illustrated, by figs. 8 and 8a, or thirty arms in the species. The arms are composed of a double series of interlocking plates and they frequently bifurcate. One tertiary series illustrated in fig. 8a shows eight arms within an inch of the calyx, and if the other arms bifurcate in like manner, there are eighty arms within an inch of the calyx, and, judging from appearances, there are numerous bifurcations above those shown in the specimen.

First interradial hexagonal, smaller than a second primary radial, followed by two smaller plates, in the second series, three smaller ones in the third series, and three smaller ones in the fourth series, that unite with the plates of the vault.

The first azygous plate is smaller than a first primary radial, it is followed by two plates in the second series, three in the third, and four in the fourth, above which the plates are not determined.

This species is remarkable for the great height of the vault and large proboscis, in proportion to the size of the calyx. It is also remarkable for the number of arms and their bifurcations.

Found in the Keokuk Group, in Greene county, Illinois, and now in the Illinois State Museum and numbered 2594.

Actinocrinus lobatus was described by Hall, in 1859, in his Supplement to the Geology of Iowa, page 51, without an illustration. It has never been illustrated, and we are not sure that we have ever seen a specimen of it. The vault is described as "irregularly convex above," while this species is remarkable for its conical vault and extremely large proboscis. The calyx is described as "distinctly divided into lobes by the depression of the interbrachial and anal spaces," which is not the case in this species. That species could not "have had more than twenty-five arms," while this species has not less than thirty. That species has four regular interradials in the fourth range, while this species has only three. The surface of the plates, in that species is traversed by "sharp ridges," in this species the ridges are low and broadly rounded. The nodes on the radial series, in that species are transverse, in this species they are longitudinal. The ridges "from the first radials to the basal plates are four," in that species, in this species there is only one; those from one first radial plate to the other in that species are two, in this species only one; those from the first radial to the second, in that species are two, in this species there is only one. Hall compared that species, with *Actinocrinus lowei*, from which he distinguished it in a few minor particulars, but this species is so far removed from *A. lowei* in every important particular, that no one would think of comparing the two. There are no two species of *Actinocrinus* farther removed from *A. lowei* and *A. lobatus*, than the one here under consideration, and we are quite at a loss to understand why the late distinguished palæontologist, Prof. Worthen, should have thought of identifying this species with either one of them. The mistake may have been overlooked because he died before the publication of the work.

ACTINOCRINUS ERRATICUS, n. sp.

Plate II, Fig. 2, view opposite the azygous side; Fig. 3, azygous view.

Body medium size. Calyx very little larger than the dome, somewhat obpyramidal, the radial series being slightly more prominent than the interradials, diameter one-half greater than the height; plates thick, tumid and sculptured. Dome elevated at the arm openings, subpyramidal, being most prominent in the direction of the radical series and covered with tumid and spinous plates. Proboscis central.

Basals short, more than three times as wide as high, projecting beyond the column, in the form of a small rim, separated at the sutures, so as to have a somewhat hexagonal outline; sculptured longitudinally, so as to show a short ridge directed toward each adjoining plate.

First primary radials the larger plates of the body, nearly as long as wide, very tumid transversely and having a short ridge directed toward each adjoining plate. Second primary radials a little smaller than the first, wider than long, transversely tumid and having a short ridge directed toward each adjoining plate. Third primary radials about as large as the second, much wider than high, transversely tumid, having radial ridges, and bearing upon each upper sloping side a single secondary radial, which, in turn, supports upon each upper sloping side two tertiary radials. There are twenty arm openings to the vault.

First regular interradials of the same size as the second primary radials; each one bears a strong central tubercle with a radiating ridge directed toward each adjoining plate; it is followed by two smaller plates, each of which bears a central tubercle; these are followed by two still smaller plates, each bearing a central tubercle, and these are followed by a single non-tuberculated plate within the interradial area proper, making six plates in the area. The last one, however, is followed by a long narrow plate, that separates the tertiary radials and unites with the plates of the vault.

There are eight plates in the azygous area. The first one is in line with the first radials, and of the same size; it is equally as tumid and sculptured in the same manner; it is followed by two plates of the same size as the second primary radials or first regular interradials, and each one bears a strong central tubercle, with a radiating ridge directed toward each adjoining plate. These are followed by three smaller plates, each of which bears a central tubercle with radiating ridges toward the plates below. These are followed by two small non-tuberculated plates, which terminate the azygous area proper, though two or three small, elongated plates separate the tertiary radials and connect with the plates of the vault.

This species has the general aspect of *A. proboscidialis*. The radial series, however, are more prominent and the interradial and azygous areas larger, and each contains twice as many plates. It is quite as far removed from *A. dalyanus*, in the structure of the interradial areas, and in the surface ornamentation.

It was found in the Drift, at Danville, Illinois, but no doubt belongs to rocks of the age of the Burlington Group, immediately north of Danville, and which are covered by the Drift. The type is in the collection of Wm. F. E. Gurley.

ACTINOCRINUS ARROSUS, n. sp.

Plate II, Fig. 4, side view of a calyx, somewhat flattened.

Specimen medium size. Calyx with a flanging base abruptly truncated below, and rapidly expanding tertiary radials. Length and breadth nearly equal; plates tumid and sculptured. Vault, proboscis and arms unknown.

Basals short, about half as high as wide, sharply flanged below so as to make a broad, flat base with deep notches at the basal sutures. The plates are longitudinally furrowed, so as to further interrupt the flange and give it additional notches.

First primary radials the larger plates of the body, as long as wide, very tumid and protuberant, and having a small ridge directed toward each adjoining plate. Second primary radials about half as large as the first, nearly as long as wide, though unequal in size and shape; two are quadrangular, two pentagonal and one hexagonal; they are tumid and have a small ridge directed toward each adjoining plate. Third primary radials of unequal size and shape, some larger than the second radials and others much smaller; they are pentagonal, hexagonal and heptagonal; they are tumid, have radial ridges, and bear upon each upper sloping side a single secondary radial, which in turn supports upon each upper sloping side two tertiary radials. There are twenty arm openings to the vault.

First regular interradials larger than the second primary radials, very tumid and bearing a small radiating ridge directed toward each adjoining plate; it is followed by two much smaller plates, each of which bears a central tubercle, with a radiating ridge directed toward each adjoining plate; these are followed by a single plate that separates the secondary radials. The tertiary radials come together, and hence there are only four plates in any regular interradial area.

There are only four plates in the azygous area. The first one is in line with the first radials, fully as large and rather longer, quite as tumid and sculptured in the same manner. It is followed by two plates that are nearly as long as the second and third primary radials together, each one bears a very strong central tubercle with a radiating ridge directed toward each adjoining plate. These are followed by a single plate that bears a central tubercle and separates the secondary radials. The tertiary radials come together.

One side of our specimen is longer than the other and the inequalities in the plates might be ascribed to that and the whole credited to an abnormal specimen belonging to some other species. The fact that the tertiary radials unite at the base of the arms would lead one to think that it is a *Batocrinus*, but below that part it has the characters of an *Actinocrinus*. We do not know of any species with which it should be compared.

Found in the Burlington Group, at Burlington, Iowa, and now in the collection of Wm. F. E. Gurley.

ACTINOCRINUS PLAGOSUS n. sp.

Plate II, Fig. 5, azygous side view of calyx; Fig. 6, crushed specimen, showing the arms.

Species medium or below medium size. Calyx obconoidal, moderately truncated below, wider than high; plates thin, surface ornamented with delicate radiating ridges or mere stripes that show slight sculpturing. Vault and proboscis unknown.

Basals short, twice as wide as high, standing upright and longitudinally marked with three or four delicate stripes.

First primary radials the larger plates of the body, as long as wide, slightly convex, and bearing a delicate ridge directed toward each adjoining plate. Second primary radials, less than half as large as the first, hexagonal, and ornamented with delicate ridges. Third primary radials about as large as the second, pentagonal and hexagonal, ornamented with delicate radial ridges and bearing upon each upper sloping side a single secondary radial, which, in turn, supports upon each upper sloping side two tertiary radials. There are twenty arm openings to the vault.

Regular interradials six. First one smaller than a second primary radial, it is followed by two smaller plates and these by two still smaller ones and these by a single plate, above which a long narrow plate unites with the plates of the vault.

There are ten plates in the azygous area. The first one is in line with the first primary radials and of the same size and sculptured in the same manner; it is followed by two plates of about the size of the second radials, and these are followed by four smaller plates, and these by two plates and these by a single plate that unites with an elongated plate that connects with the plates of the vault.

The arms are very long and comparatively coarse and composed of a double series of interlocking plates. Pinnules dense.

Distinguished by the delicate sculpturing and number of interradial and azygous plates.

Found in the Burlington Group, at Burlington, Iowa, and now in the State Museum, at Springfield, Illinois.

ERETMOCRINUS LYONANUS, n. sp.

Plate III, Fig. 1, basal view of a specimen crushed, with proboscis down and arms expanded, on the surface of a rock.

Calyx short, below medium size; plates thin, slightly convex and smooth. The basal plates and some in each radial series are destroyed, in our specimen, so as to make an accurate description of all of them quite impossible. The first primary radials are longer than wide and the larger plates of the calyx. The second primary radials are small, leaving comparatively wide interradial areas. The secondary and tertiary radials are short.

Some of the arms are well preserved and others torn into pieces. There are, as it appears, twenty very long, compound, ponderous arms, remarkable for their expansion, in the upper part. There are also twenty arm openings to the calyx. There are three single, short plates in the commencement of each arm; these are followed by a double series of interlocking plates that are deeper than wide, making the arm in the lower part deeper than wide. The arms gradually widen externally until they are about four times as wide as deep. In the lower part of the arms the arm furrows are shallow and the arms are twice as deep as wide, they do not increase, in depth, in the upward extension, even where they are four times as wide as deep.

This species is distinguished from all others by the thin, smooth, slightly convex plates of the calyx and by the remarkably heavy arms.

Found in the upper layers of the Burlington Group, near Burlington, Iowa, and now in the State Museum, at Springfield, Illinois. The specific name is in honor of one of the founders of the genus, the late distinguished palæontologist, Sidney S. Lyon, of Jeffersonville, Indiana.

BATOCRINUS LYONANUS, n. sp.

Plate III, Fig. 4, view opposite the azygous area; Fig. 5, basal view.

Body above medium size. Calyx basin shaped, and spreading horizontally from the secondary radials; two and a half times as wide as high; plates thick, angular; sutures beveled; arm openings directed horizontally. Vault conical, nearly as large as the calyx, covered with polygonal, tumid plates and having a large subcentral proboscis.

Basals short, more than three times as wide as high and excavated below, so the concavity has a depth greater than the external height of the plates. First primary radials one and a half times as wide as high. Second primary radials quadrangular, half as large as the first, and only a little wider than high. Third primary radials a little larger than the second and bearing upon the upper sloping sides the secondary radials. There are two secondary radials in each of three radial series, the second one being about twice as large as the first and bearing upon each upper sloping side three tertiary radials, thus giving to each of these three radial series four arms. The radial series on the left of the azygous area has one-half of it constructed in the same manner; the other half, being the one most distant from the area, possesses no tertiary radials, but has four secondary radials, and, therefore, in this series, there are only three arms. The radial series opposite the azygous area has no tertiary radials, but it has four secondary radials on each of the upper sloping sides of the third primary radials, and, therefore, there are only two arms in this series. The species has only seventeen arm openings to the calyx.

In each regular interradial area there are three plates, the first of which are the larger plates of the calyx, and each one has eight sides. It rests between the upper sloping sides of the first primary radials and the second and third primary radials abut it on each side, and it supports, on top, the other two interradials. The upper interradials are never of equal size; they are situated between the first secondary radials and below the tertiary radials.

The azygous area is subovate in form, and contains six plates. The first one is in line with the first primary radials and of the same size. It is followed by three plates, that differ but little in size, and these are followed by two plates, in the third range, that are situated between the second secondary and first tertiary plates, and thus extend a little higher than the plates do, in the regular interradial areas.

In *Batocrinus facetus* the three armed series is on the right of the azygous side, in this it is on the left. In that species, there are four regular interradials and eleven azygous plates, in this species, there are three regular interradials and six azygous plates. It is a marked species that cannot be mistaken for any other one.

Found in the St. Louis Group, in Hardin county, Kentucky, and now in the collection of Wm. F. E. Gurley. The specific name is in honor of the late Sidney S. Lyon, who did so much valuable work in this family of crinoids.

BATOCRINUS ALTIUSCULUS, n. sp.

Plate V, Fig. 1, side view, azygous area on the right; Fig. 2, azygous view; Fig. 3, summit view of the same specimen, part of the top being broken away.

Body large, above the medium size. Calyx long, somewhat bell-shaped, very slowly and somewhat evenly expanded from the base to the second radials and then spreading horizontally; nearly as high as wide; arm openings directed horizontally; plates convex; sutures depressed; surface smooth or finely granular.

Basals form a subcylindrical cup nearly as high as wide, truncated and round at the base, with a round facet for the attachment of the column deeply impressed, and about two-thirds of the diameter of the base. The columnar canal is large and pentagonal. A little above the truncated base there is a high transverse ridge across each plate, that is broken at the sutures, giving to this band when viewed from below a sub-hexagonal outline. Above the band the basals slowly expand. First radials longer than wide, nearly as large as the basals, lower third most convex, three hexagonal, two heptagonal, and rising almost vertically from the basals. If the usual quadrangular second radials exist, in this species, they are anchylosed with the third radials, in our specimen, so as to form single pentagonal plates about one-third as large as the first radials, axillary, and bearing upon each upper sloping side two secondary radials, the second being larger than the first. The second secondary radials are axillary and bear two or three tertiary radials upon each superior sloping side, which gives to the species twenty arm openings to the vault.

Regular interradials, two in each area, one above the other, the second one less than half as large as the first, and situated between the secondary radials. There are seven plates in the azygous area. The first one is in line with the first primary radials and of about the same size, being slightly narrower and a little longer. It is followed by a range of three plates, each of which is about one-third as large as the first. There are three small plates in the third range, below the tertiary radials, in the adjoining radial series.

Vault elevated over the arm openings, convex and having, comparatively, a small subcentral proboscis. It is composed of very irregular, polygonal, tumid plates, without any apparent order as to size or arrangement. The proboscis is broken off so its length is not ascertained.

This species bears most resemblance to *B. christyi*, from which it is distinguished by the longer form of the calyx, longer basals, longer and more convex first radials, shorter second and third radials (if this species possesses the second quadrangular plate) more elevated vault over the arm openings, less convex beyond, smaller proboscis, and more tumid plates. Indeed very slight observation will distinguish the two species.

Found by the laborious naturalist and indefatigable collector, R. A. Blair, of Sedalia, Missouri, in the upper part of the Burlington Group near Blackwater Station, a few miles west of Booneville, in that State, and with his usual generosity presented to one of the authors—S. A. Miller.

BATOCRINUS ASPRATILIS, n. sp.

Plate V, Fig. 4, azygous view; Fig. 5, lateral view; Fig. 6, summit view.

Body of our specimen unsymmetrical, one side larger than the other, which may or may not be abnormal. The species is of medium size and the vault is nearly as large as the calyx. Calyx broadly truncated at the base and very rapidly expanding in the upper part; about half as wide as high; arm openings directed horizontally; plates highly convex; sutures distinct; surface granular.

Basals thick and form a low subhexagonal cup, about three times as wide as high, with a round, deep columnar depression, having a concave, radiately furrowed bottom, for the attachment of the column. The base is about two and a half times as wide as the diameter of the column. The basal plates stand nearly upright; they are flattened, in the central part, and beveled toward the sutures, which makes the cup hexagonal. First radials smaller than the basals, of unequal size, and about twice as wide as high, three hexagonal, two heptagonal, and directed at an angle of about thirty degrees from the basals. Each one is transversely, highly convex, the elevation being obtusely angular.

Second radials quadrangular and very short, being from three to six times as wide as long. Third radials pentagonal, twice as wide as high, convex in the central part, axillary, and bearing upon each upper sloping side two secondary radials. The second secondary radial is larger and much wider than the first, axillary, and bears upon each upper sloping side two or three tertiary radials. On one side of our specimen, there are only two tertiary radials, in each series, and on the other side there are three, in each series, which makes one side of the calyx larger than the other. The proximate ray on each side of the azygous area has an axillary tertiary radial so that each of these rays has five arm openings to the vault. This gives to the species twenty-two arm openings to the vault.

There is only one regular interradial in each area, which is a large, tumid, conspicuous plate. There are five azygous plates. The first one is in line with the first radials and of nearly the same size and quite as tumid. There are three plates in the second range, the middle one being a short quadrangular plate, twice as wide as long, the lateral ones being comparatively large, tumid plates. There is only one plate in the third range, which is nearly as large as the first and very tumid. The azygous area is slightly wider than high, or nearly square in outline, with a flat, wide, quadrangular plate, in the center, surrounded by four tumid plates occupying the angles of the square.

Vault somewhat elevated over the arm openings, convex toward the central part and having a subcentral proboscis. It is composed of irregular, polygonal, tumid plates arranged, in some order, as five quite tumid plates, half way from the margin to the center, are in line with the primary radial series. The proboscis being broken off, and the length is unknown.

This species is so different from all others having twenty-two arms, that it is unnecessary to make a comparison with any of them for the purpose of distinguishing it. The single, regular interradial and the arrangement of the five azygous plates, with their peculiar shape and convexity will alone distinguish it from all other described species.

Found by R. A. Blair, in the Burlington Group, at Sedalia, Missouri, and now in the collection of S. A. Miller.

BATOCRINUS SCYPHUS, n. sp.

Plate V, Fig. 7, azygous view; Fig. 8, lateral view; Fig. 9, summit view.

Body medium size. Calyx bowl shaped, rounded at the base and very gradually expanding to the summit; about one-third wider than high; arm openings within the upper margin of the summit and directed upward; plates thin, plain, not convex; sutures not very distinct; surface smooth or granular.

Basals very low, curving into the columnar cavity and upward about as high as the depth of the cavity. First radials the larger plates of the body, wider than high, gradually expanding, three hexagonal, two heptagonal. Second radials quadrangular, about twice as wide as high. Third radials short, twice as wide as high, pentagonal, axillary, and bearing upon each upper sloping side two secondary radials. The second secondary radials are axillary, larger and wider than the first, and bear upon each upper sloping side, in four of the radial series, two tertiary radials; but in the ray opposite the azygous area, there is only one tertiary radial, in each series, one of which is smaller than the other. There are, therefore, twenty arm openings to the vault, but two of the openings opposite the azygous area are smaller than the others, and, hence, it would appear, that the arms are not of equal size; probably sixteen or eighteen are uniform, and the other two or four, as the case may be, are smaller or have fewer divisions. The arms themselves are wholly unknown, and the facet for their articulation is very obscure, in our specimen. They must have been very small and peculiarly constructed, with an extraordinary covering of the arm furrows, if we may be allowed to judge from the appearance of the orifices.

There is only one regular interradial plate in each area; it is nearly as large as the second and third radials together, or about half as large as a first radial. The azygous area is large and contains seven plates. The first one is in line with the first radials and rather longer; it is followed by three plates, the middle one of which is the larger and about the size of a regular interradial, and this range is followed by three rather large plates in the third range.

Vault depressed convex with a very small, short, subcentral proboscis. It is covered with irregular, polygonal, gently convex plates. The proboscis seems to be complete, except the covering, in our specimen, though it is possible small plates may have been broken from the top of it. It is evident it could not have been much higher.

This species agrees with *Batocrinus* in the plates of the calyx, but differs in all other respects from all described species. The arm openings and proboscis are peculiar and different from those in any other known species.

Found by R. A. Blair, in the Burlington Group, at Sedalia, Missouri, and now in the collection of S. A. Miller.

BATOCRINUS LAETUS, n. sp.

Plate V, Fig. 10, view opposite the azygous area; Fig. 11, azygous side view; Fig. 12, summit of same specimen.

Body medium size. Calyx obconoidal, truncated at the base, a little less than twice as wide as high, arm openings directed horizontally; plates thick, very highly convex, the convexity generally angular; sutures distinct; surface granular.

Basals moderately thick, and form a low, hexagonal cup, twice as wide as high, with a round deep columnar depression, having a concave, radially furrowed bottom, for the attachment of the column. The base is about twice as wide as the diameter of the column. The basal plates stand upright; they are flattened in the central part, and beveled toward the sutures, which makes the cup hexagonal. It will be observed, that the basals form a cup like that of *B. aspratilis*, except the plates are somewhat thinner. First radials longer than the basals, but somewhat shorter and of unequal size; they are, however, wider than long, three hexagonal and two heptagonal, with the superior sides slightly arcuate. Each one is transversely, highly convex, the elevation being obtusely angular. Second radials quadrangular, and about three times as wide as high. Third radials pentagonal, twice as wide as high, convex in the central part, axillary, and bearing upon each upper sloping side two secondary radials. The second secondary radials are only a little larger than the first, axillary, and bear upon each upper sloping side two tertiary radials. The proximate ray on each side of the azygous area has an axillary, tertiary radial, so that each of these rays has five arm openings to the vault. This gives to the species twenty-two arm openings to the vault.

There are two regular interradials in each area; the first one is very tumid, and about as large as the second and third primary radials together; the second one is about one-third as large as the first and quite convex. The azygous area is about as wide as high and contains six plates. The first one is in line with the first radials and fully as large and tumid. It is followed by three plates, in the second range, and two in the third, all of which are tumid and subequal in size.

Vault elevated, above the arm openings, and gently convex, toward the central part, and bearing a coarse, central proboscis. It is composed of irregular, polygonal, subspinous plates, arranged, so far as discovered, without order, in respect to the different radial areas. The proboscis commences, at the base, with a very large, transversely tumid plate, opposite the azygous side. The length of the proboscis is unknown.

This species is so different from all others bearing twenty-two arms, that no comparison is necessary to distinguish it.

Found by R. A. Blair, in the Burlington Group, at Sedalia, Missouri, and now in the collection of S. A. Miller.

BATOCRINUS ÆQUABILIS, n. sp.

Plate V, Fig. 13, azygous view; Fig. 14, view opposite the azygous side; Fig. 15, summit of same specimen.

Calyx and vault somewhat equal in dimensions and together, somewhat wheel-shaped. Rather below the medium size. Calyx broadly truncated at the base, gently expanding to the top of the primary radials and then abruptly spreading horizontally to the free arms; more than twice as wide as high; arm openings directed horizontally; plates thick, highly convex on the lower part, but much less so above; sutures moderately distinct; surface granular.

Basals thick and form a low, hexagonal cup, about three times as wide as high, with a round, shallow, columnar depression, having a concave radiately furrowed bottom for the attachment of the column. The base is full twice as wide as the diameter of the column. The basal plates stand upright, they are flattened in the central part, and beveled toward the sutures, which makes the cup hexagonal. It will be noticed that the basals form a cup similar to that of *B. aspratilis*, except having a shallow, instead of a deep columnar cavity. First radials somewhat smaller than the basals, wider than long, three hexagonal, two heptagonal. Each one is transversely tumid. Second radials quadrangular and, at least, four times as wide as high, third radials pentagonal, very short, four times as wide as high and bearing upon each upper sloping side two secondary radials. The second secondary radials are much wider than the first, axillary, and bear upon each upper sloping side two tertiary radials. There are twenty arm openings to the vault.

There is only one regular interradial in each area, and it is a large tumid plate. The azygous area is fully as wide as long and contains four plates. The first one is in line with the first radials, rather larger and more tumid. There are three plates in the second range, the middle one being about as large as the other two together.

Vault moderately elevated over the arm openings and quite convex toward the central part. It bears a rather large, subcentral proboscis, the length of which is unknown. The vault is composed of irregular polygonal, subspinous plates, arranged, so far as discovered, without order, in respect to the radial areas. The proboscis commences at the base, opposite the azygous side, with a very large, transversely tumid angular plate.

This species is so different from all other trochiform species and from all others bearing twenty arms, that no comparison is necessary to distinguish it.

Found by R. A. Blair, in the Burlington Group, at Sedalia, Missouri, and now in the collection of S. A. Miller.

STROTOCRINUS VENUSTUS, n. sp.

Plate VI, Fig. 1, side and basal view of the calyx.

Calyx medium size, urn shaped, below the tertiary radials, from which place it abruptly spreads horizontally. Surface deeply sculptured. Column round and perforated by a rather large subpentagonal canal.

Basals low, thick, deeply sculptured, notched at the suture lines, hexagonal in outline and extending below the columnar facet, where small nodes are made to terminate the sculptured ridges. First radials highert han wide, tw oheptagonal and two hexagonal and one pentagonal, central tubercle transverse and sending two ridges to the basal plates and one to each of the other adjacent plates. Second radials hexagonal, wider than high, a little smaller than the first radials, central tubercle only slightly elongated transversely, from which a ridge is directed to each adjoining plate. Third radials a little smaller than the second, wider than high, hexagonal, and bearing on the upper lateral sides a single secondary radial. Secondary radials smaller than the third primary radials and supporting on one of the upper sloping sides a single tertiary radial and on the other a series of three or more tertiary radials, before the arm becomes free; the exact number cannot be determined from our specimen. The single tertiary radials bear an axillary plate of the fourth order, which supports, on each upper sloping side, two or more plates before the arms becomes free. There are, therefore, at least twelve arms in each radial series or sixty arm openings to the vault in this species.

First regular interradial hexagonal, as large as the second primary radials, sculptured in the same way, and supporting two smaller but similar plates in the second range. The latter are followed by two smaller plates and these by one still smaller plate, which gives us six plates in each regular interradial area. There is one plate in each intersecondary radial area that rests on the third primary radial. There are nine plates in the azygous area. The first one is in line with the first radials, of the same size and sculptured in like manner. It is followed by three plates in the second range and these in turn by three smaller plates, above which there are two still smaller plates before the tertiary radials unite to cut off the azygous area from the plates of the vault.

The sculpturing on the plates in this species is similar to that on *Strotocrinus ectypus*, but otherwise it bears little resemblance to that species. It is so different in the form of the calyx and number of the interradials from *S. regalis* and kindred species that no comparison with any of them is necessary to distinguish it.

Found in the Burlington Group, at Burlington, Iowa, and now in the Illinois State Museum, at Springfield.

BLAIROCRINUS SPINOSULUS, n. sp.

Plate VII, Fig. 16, azygous view; Fig. 17, view opposite the azygous area; Fig. 18, summit view.

Calyx truncated at the base, obpyramidal, about twice as wide as high; plates sculptured; radial ridges rather sharp; interradial area flat; secondary radials and arm openings directed horizontally.

Basals three, forming a low, irregular, subhexagonal disc, nearly covered below by a round column, which is attached to the basals, by radiating denticulations. Columnar canal rather large, pentalobate. The little rim formed by the basals bears a node or short ridge directed toward each adjoining plate above. First primary radials the larger plates of the calyx, wider than high, three hexagonal, two heptagonal, convex in the central part, and sunken at the angles so as to leave a short ridge directed toward the center of each adjoining plate. Second primary radials quadrangular, about twice as wide as high, and similarly sculptured, though the radial ridge is much stronger than the transverse one. Third primary radials about the same size as the second, pentagonal, axillary, and bearing upon each upper sloping side two secondary radials, While there are only ten secondary radial series, there are two arm openings over each series, indicating that the arms, at once, bifurcated on becoming free.

Regular interradials three, one hexagonal plate resting between the upper sloping sides of the first primary radials and followed by two smaller elongated plates, that separate the secondary radials and connect with the plates of the vault. The first azygous plate is in line with the first primary radials, of about the same size, and sculptured in like manner. It is followed by two plates, in the second range, and three in the third range, which separate the secondary radials and connect wlth the plates of the vault.

The vault is strongly pentalobate, by reason of the horizontally projecting secondary radials extending beyond the upper part of the interradial areas. It is elevated over the arm openings, and gently convex toward the center. There is a spinous plate over each double arm opening, and between these spinous plates, in each radial series, there is a rather large plate, that separates them on a level with the top of the secondary radials, behind which there is a single large, spinous plate. The arrangement of these three spinous plates, over each radial series, is very much like it is in *B. trijugis*. The plates of the vault are rather large, and four of them bear very strong spines in addition to those above mentioned. The proboscis is subcentral, and probably very much like that in *B. trijugis*, though the top of it is broken off in our specimen.

The general form of this species will readily distinguish it from all others that have been described. It is most nearly related to *B. trijugis*, but in addition to the general form, it may be distinguished by having fewer plates in the interradial and azygous areas and by the plates of the vault.

Found by R. A. Blair, in the Chouteau Limestone, at Sedalia, Missouri, and now in the collection of S. A. Miller.

FAMILY CYATHOCRINIDÆ.

CYATHOCRINUS ANDERSONI, n. sp.

Plate III, Fig. 2, symmetrical side; Fig. 3, azygous side.

Calyx large, deep, cup-shaped, longer than wide, oblique, longer on the symmetrical than on the azygous side; plates very thick, tumid, and ornamented with wart-like protuberances; sutures very distinct. Column round and composed of plates near the calyx, which are highly inclined toward the azygous side.

Basal plates quite uniform, in size, and forming a round basin nearly three times as wide as high; each plate bears a strong, central tubercle and some of them have two tubercles. Subradials twice as large as the basals, four hexagonal and one heptagonal, very tumid and each one is ornamented, in the central area, with several large tubercles. irregularly disposed, and some of which are confluent. First radials larger than the subradials, tumid, deeply notched for the arm furrows and curving in at the superior lateral angles; facet for the reception of the second radials large and excavated downward two-thirds the length of the plates; plates ornamented. below the facet, with irregular tubercles. First azygous plate quadrangular, longer than wide, and resting upon the upper truncated side of the heptagonal subradial, and rising to the level of the bottom of the arm-furrows, in the first radials. The surface of it is also tuberculated.

This species is related to *C. farleyi.* Our specimen is much larger than the type of *C. farleyi,* which might account for differences in the surface ornamentation, if there were not other differences of specific importance. In that species, the basal plates are proportionally much smaller than they are in this, and form a flattened pentagonal disc, while in this, they form a basin, which increases the comparative length of the calyx. The superior lateral angles of the first radials, in that species, are truncated and stand upright, while in this species, they curve in over the margin of the vault and are not truncated. The facets for the second radials are proportionally much smaller, in that species, than they are in this, which indicates differences in the construction of the arms. As these differences in the construction of the calyx must rank as of specific importance, the surface ornamentation may also be used to distinguish the species.

Found in the Keokuk Group, at Keokuk, Iowa, and now in the collection of Wm. F. E. Gurley. The specific name is in honor of D. G. Anderson, of Keokuk, Iowa, from whom this specimen was obtained.

CYATHOCRINUS TUMIDULUS, n. sp.

Plate III, Fig. 7, view opposite the azygous side. Specimen somewhat flattened and the ends of the arms broken away.

Species medium size and bearing very heavy arms. Calyx low, basin shaped; sutures depressed; surface granular.

Basals small and apparently hidden by the column in the concavity of the lower side of the calyx, though, as our specimen is depressed, it is probable that the basals may be seen in a better specimen extending slightly beyond the column. Subradials large and remarkably tumid, being roughly hemispherical externally. First radials a little smaller than the subradials, tumid, transversely angular in the middle part and truncated the entire width above. Second radials quadrangular, transversely angular in the middle part, and more than twice as wide as high. Third radials in four of the rays pentagonal, axillary, and supporting upon each of the upper sloping sides a single arm. The ray opposite the azygous area consists of a single arm, which commences on the first radial with a quadrangular plate as in the other series. This gives to the species only nine arms.

The first azygous plate truncates a first radial and extends nearly as high as the first radials, and has a short upper side on which rests a smaller plate.

Arms long, coarse, rough, and composed of short, more or less cuneiform plates, projecting on alternate sides above for the reception of short, stout pinnules.

This species is remarkable for the tumid subradials, large, rough arms and short, stout pinnules. The calyx is that of a *Cyathocrinus*, but the arms and pinnules resemble those in some species of *Scaphiocrinus*. This species is so different from any hitherto described that no comparison with any of them is necessary to distinguish the species.

Found in the Keokuk Group, on Indian creek near Crawfordsville, Indiana, and now in the collection of Wm. F. E. Gurley.

CYATHOCRINUS SIGNATUS, n. sp.

Plate VI, Fig. 10, side view of calyx and part of the arms.

Calyx small, cup-shaped, height a little more than the diameter; sides unequal; sutures distinct; plates slightly convex; surface smooth or granular; column small.

Basals form a shallow cup with sharp superior angles. Subradials rather longer than wide and about twice as large as the basals. There appears to be only four subradials, in our specimen. The plate on the right of the illustration occupies the place of a subradial and radial, while the azygous plate truncates the subradial on the right of it. Possibly the plates are anchylosed, or the specimen is abnormal. First radials unequal in size and not uniform in shape. The arm facets occupy about half the width of the plates, face outward, and the superior lateral sides of the first radials slope down to the sutures. The arms are very different from each other and divide with great irregularity, but they divide so frequently that there are more than a hundred and probably twice that many of them. They are composed of rather long pieces. The azygous plate broadly truncates a subradial and is about as large. The proboscis may be seen within the labyrinth of small arms in our specimen, where it is composed of large plates and appears to be balloon shaped. This species would seem to have its relations with *C. labyrinthicus*, though it is so different that no comparison is necessary to distinguish it.

Found in the Keokuk Group, in Washington county, Indiana, and now in the collection of Wm. F. E. Gurley.

BARYCRINUS FORMOSUS, n. sp.

Plate III, Fig. 6, azygous view of calyx, arms and column.

Species, as indicated by our specimen, rather below the medium size. Column moderate size, pentagonal and composed of alternately thicker and thinner plates. Calyx broadly bowl-shaped, twice as wide as high; plates thick, depressed laterally and at the angles, and swelling in the middle part so as to form broadly rounded radial ridges; surface smooth or very finely granular.

Basal plates forming a pentagonal disc nearly covered by the column. Subradials the larger and more tumid plates of the body, longer than wide, four hexagonal and one heptagonal. First radials wider than long, deeply sunken at the lateral angles, and each having a broadly rounded radial ridge in the middle; facets for the reception of the second radials concave, each a little more than half the width of the plate, suture gaping; superior lateral angles sharply truncated for the reception of the summit plates. Second radials short, transverse, rounded plates, a little longer in one of the rays than in either of the other three preserved in our specimen. Third radials longer than the second, axillary and supporting upon each upper sloping side heavy, strong arms.

First azygous plate large, quadrangular, wider than high, resting upon the upper side of the heptagonal subradial and separating two first radials. Second plate smaller than the first, but, in our specimen, it is turned in upon the vault so as not to expose the entire surface.

Arms ten, two from each ray; short, heavy, rounded externally, and composed of rather long slightly cuneiform plates. Every fourth plate on each side bears an armlet, that is, every second alternate plate on opposite sides bears an armlet. The intervening plates that do not bear armlets are the shorter ones. The armlets are short and stout and bear secondary armlets as in *B. spectabilis*.

The general form of the calyx and arms will readily distinguish this from other described species.

Found in the Keokuk Group, Washington County, Indiana, and now in the collection of Wm. F. E. Gurley.

FAMILY POTERIOCRINIDÆ.

ZEACRINUS BELLULUS, n. sp.

Plate III, Fig. 8, calyx and arms, azygous side on the left.

Species below the average size, slightly constricted above the calyx, arms coming to a point at the summit, and the whole very neat in outline. Calyx low; plates convex; sutures bevelled; columnar cavity moderately deep; surface granular.

Basal plates within the calyx and covered externally by the column. Subradials rather large, barely visible, at the superior angles in a side view, convex and sutures distinct. First radials wider than high, convex, truncated the entire width above and separated from the second radials by a gaping suture. Second radials nearly as long as wide, convex longitudinally, depressed laterally toward the sutures, pentagonal, axillary and supporting upon each upper sloping side a single arm. However, the ray opposite the azygous area is not visible in our specimen, and it may, as in other species in this genus, bear only a single arm, and hence the species will possess only nine arms; but if it is like the other rays, the species has ten arms.

The arms are slightly fusiform and composed of a single series of plates which are transverse and nearly as long as wide, at first, but gradually become thinner and wider and cuneiform toward the middle part, and, without again shortening, they become narrower as the arms taper to the distal end. Each plate bears a pinnule directed upward and inward and composed of long joints.

The first azygous plate is twice as long as wide, has five sides, the lower end abuts upon a subradial, the under sloping side rests upon another subradial, and the upper sloping side abuts upon the under sloping side of the first radial on the right; one superior side abuts the second azygous plate, while the summit is truncated by the third azygous plate. The second azygous plate truncates a subradial. The third azygous plate is long and abuts one side upon the short lateral side of the first radial on the right and the side of the second radial and part of the first arm plate.

This species bears some resemblance to *Cyathocrinus maniformis* of Yandall and Shumard which has generally been referred to *Zeacrinus*. In that species the subradials are long and abruptly bend into the columnar cavity and upward so as to form a convex rim for the base of the calyx and show the upper part of the plates in a lateral view; in this species the columnar depression is much smaller and the subradials are comparatively shorter and only slightly convex so as to form a somewhat truncated base to the calyx and to show only the superior angles of the plates in a lateral view. The first radials are comparatively shorter and the second radials comparatively longer and the plates more convex in this species than they are in *Z. maniformis*. The arms in this species are more fusiform than in *Z. maniformis*. In that species there are only nine arms.

Found in the Kaskaskia Group, near Shoals, Martin County, Indiana, and now in the collection of Wm. F. E. Gurley.

ZEACRINUS OBESUS, n. sp.

Plate IV, Fig. 6, side view, with the ray opposite the azygous area on the right; Fig. 7, azygous view; Fig. 8, basal view.

Body robust. Calyx very low and round; columnar cavity deep so that the point of columnar attachment is about on a line with the top of the first radials; surface smooth or granular.

Basal plates completely within the calyx. Subradials long and narrow, extending from the bottom of the columnar cavity down and over the basal rim so as to be seen in a lateral view. First radials have a long triangular extension down into the columnar cavity, and they are separated from the second radials by a transverse suture. The second radials are wide, short, pentagonal, axillary plates, in four of the series, but in the ray opposite the azygous area, it is a quadrangular plate, a little more than twice as wide as long, and followed by a shorter quadrangular plate, which is succeeded by a short, axillary plate. The second bifurcation of the rays takes place on the fourth plate, from the first axillary plate, in all the rays except two, and in these it takes place on the fifth plate. Our specimen is not preserved so as to show any further divisions of the arms, if any take place.

The first azygous plate is long and narrow like a subradial, and extends down deep into the columnar cavity, between a subradial and the under sloping side of the first radial on the right and rises a little above the subradial. The second plate truncates the subradial, separates the first radials and extends to the top of the first secondary radial on the right and to the middle of the second secondary radial on the left. It is followed by a much smaller plate, and it, in turn, by a small triangular plate.

This species is distinguished from *Z. magnoliiformis,* the type of the genus, which it seems most to resemble, in several particulars, one of which is sufficient to distinguish the species. In *Z. magnoliiformis*, the arms bifurcate on the third and fourth plates, in this species they bifurcate on the fourth and fifth plates. The azygous side of *Z. magnoliiformis* has never been illustrated and we have no specimen of that species with which to make a comparison, but, judging from the description given, in the Geo. Sur. of Iowa, Page 544, the azygous areas in the two species are not alike. The subradials have not the same form according to the illustration of that species, by Hall. Our species is more robust and the basal cavity seems to be deeper. It has some resemblance to *Z. depressus,* a diagram of part of which is in the Geo. Sur. of Iowa, Page 546, but the azygous area will at once distinguish it.

Found in the Kaskaskia Group, at Flag Pond, Virginia, and now in the collection of Wm. F. E. Gurley.

ZEACRINUS NITIDUS n. sp.

Plate VI. Fig. 3, azygous view; Fig. 4, view of the same specimen, opposite the azygous side. The specimen is somewhat flattened.

Species below the average size, much constricted above the calyx, arms proportionally large and coming to a point at the summit. Calyx subhemispherical, base depressed; sutures distinct; surface granular.

Basal plates within the calyx and covered externally by the column. Subradials about as wide as long, sharply bending into the columnar cavity and upward so as to form a convex rim, for the base of the calyx, and to show full half the length of the plates in a lateral view. First radials about one half wider than long, truncated the entire width above and separated from the second radials by a gaping suture. Second radials of unequal length, some of them longer than the first radials and others shorter, convex longitudinally, constricted on the sides, four of them pentagonal, axillary, and supporting upon each upper sloping side a single arm; the other one, which is opposite the azygous area, is quadrangular, and has a short upper side and bears a single arm. The species, therefore, has only nine arms.

The arms are short, comparatively large, very slightly fusiform and composed of a single series of short plates, that are more or less cuneiform in the middle part of the arms. Each plate bears a pinnule directed upward and inward, which is composed of long joints.

The first azygous plate is quadrangular, a little longer than wide, placed oblique, the lower end abuts upon a subradial, the under sloping side rests upon another subradial, the opposite side abuts the under sloping side of the first radial on the right, and the superior side abuts upon the second azygous plate. The second azygous plate is larger than the first, truncates a subradial, and occupies almost the entire width of the azygous area. The third azygous plate is quite small and does not seem to extend to the first plate.

It is quite unnecessary to compare this species with *Z. bellulus*, above described, but it may be compared with the form figured by Hall, as *Z. maniformis*, which it very much resembles. Hall's specimen, however, bears only a slight resemblance to *Z. maniformis* as figured by Yandall & Shumard, in their contributions to the Geology of Kentucky, and we prefer to compare our species with that which is the true *Z. maniformis*. *Z. maniformis* has proportionally a longer and more globose calyx and much longer arms than our species. The second radials in our species are much more constricted on the sides than they are in *Z. maniformis*, and we are led to infer, from the figure, that it had ten arms while our species has only nine.

Found in the Kaskaskia Group, in Randolph County, Illinois, and now in the collection of Wm. F. E. Gurley.

SCAPHIOCRINUS MARTINENSIS, n. sp.

Plate IV, Fig. 9, Calyx, part of the column, and part of the arms.

Calyx cup-shaped, more than one and a half times as wide as high, very evenly expanding from the column to the top; sutures distinct; surface smooth or finely granular. Column small, round and composed of alternately thicker and thinner pieces.

Basals form a little cup, with sharp, high angles, at the top. Subradials twice as large as the basals. First radials larger than the subradials, wider than high, truncated nearly the entire width for the second radials, from which they are separated by a gaping suture. The upper part below the gaping suture is quite prominent and convex in the middle part, and the superior lateral angles are slightly truncated, leaving the suture at the top depressed. The second radial or first brachial, in the only arm preserved, in our specimen, has a length greater than the diameter at the upper end, and the second brachial is longer than its greatest diameter, axillary, and supports an arm upon each upper sloping side. The two brachials together, are round externally and contracted on the sides.

The arms are short and coarse, one of them divides on the seventh plate and the other remains single throughout its length. The arms are composed of remarkably long, cuneiform, alternately projecting plates, that bear alternately, short, strong, long-jointed pinnules. Only pieces of the other arms are preserved, in our specimen, but one of them is shown to have had only a single brachial, which is long, contracted in the middle, at the sides, and axillary. The arms are not, therefore, uniform in structure. The azygous side is not visible.

This species is so different from any hitherto described, that no comparison with any of them is necessary, in order to distinguish it.

Found in the Kaskaskia Group, in Martin County, Indiana, and now in the collection of Wm. F. E. Gurley.

SCAPHIOCRINUS ARROSUS, n. sp.

Plate VI, Fig. 5, azygous view of calyx and arms.

All the plates of the calyx and arms are angular and present a very rough aspect. The plates of the calyx, though small, are deeply sculptured. The calyx is low, less than half as wide as high. The column is obscurely pentagonal, and composed near the calyx of thin plates radiately furrowed near the outer circumference.

Basals small, hidden by the column. Subradials small, wider than high, directed outward, hexagonal, except the one on the azygous side, which is truncated at the top and heptagonal, each one is produced into an angular node, at the central part. First radials pentagonal, about half as high as wide, sharply angular, or having a ridge at the upper part and a radiating ridge from the central part to each adjoining subradial. Horizontally truncated the entire width of the plate on top, where the suture is gaping. Second radials quadrangular, about half as long as wide, sharply angular in the central part; sutures gaping. Third radials pentagonal, nearly as high as wide, axillary, sharply angular in the central part, upper sides very steep and each supporting an arm.

The bifurcation of the arms is not uniform, in the different rays. The one on the left of the azygous area bifurcates on the fourth plate, while the four on the right of the azygous area bifurcate on the sixth plate. One of the arms does not bifurcate again, but the other one bifurcates once, though not at uniform distances from the first bifurcation. This method of dividing the arms gives to the species, in the upper part, thirty arms. The arms are angular externally, and composed of slightly cuneiform plates that bear coarse pinnules.

The azygous plates are sculptured, the central part of each being most prominent, and arranged in alternate order, the first one is inserted obliquely between the subradial and a first radial.

The calyx of this species resembles the calyx of *Scaphiocrinus bonoensis*, but the arms are not half as numerous and are wholly different, after the first division. We do not know of any other species with which it is necessary to compare it.

Found in the Keokuk Group, in Washington county, Indiana, and now in the collection of Wm. F. E. Gurley.

HYDREIONOCRINUS SANCTILUDOVICI, Worthen.

Plate VI, Fig. 2, view of the type.

Prof. Worthen, in Volume VIII of the Geo. Sur. of Illinois, page 98, gave a short description of this species, under the name of "*Eupachycrinus sanctiludovici,*" but did not illustrate it. We have figured the type of the species, which is very fragmentary, as stated by Prof. Worthen, but from the expanded summit of the vault and the short, strong spine, shown on the right of the illustration, we suppose it to belong to the genus *Hydreionocrinus*, to which we have referred it. It occurs in the St. Louis Group, at St. Louis, Missouri, and from his imperfect description and our illustration, the species may be identified.

HYDREIONOCRINUS SUBSINUATUS, n. sp.

Plate VI, Fig 11, azygous side view of the calyx; Fig, 12, basal view of same specimen; Fig. 13, azygous side view of another specimen, preserving part of the spinous second radials; Fig. 14, basal view of same specimen.

Calyx depressed, saucer-shaped, slightly concave below, longitudinally concave on the ventral side; sutures distinct; surface smooth. When viewed from above or below, hexagonal, in outline, by reason of the truncated first radials, and the concave, wide azygous area. Column round.

Basals form a pentagon one-half wider than the column, with a central, columnar cavity surrounded by an external rim, for the support of the attaching column. Subradials of moderate size, three of them apparently pentagonal, though as each one abuts upon two basals, where there is an obsure angle, they are really hexagonal. The two adjoining the azygous area are heptagonal. They curve very slightly down to the basals, and upward, toward the acute angles between the first radials. They are not uniform in size or shape; the heptagonal plate on the right of the azygous area is the wider, and the one on the left the longer one. First radials twice as wide as high, truncated the entire width above, much thickened within, and separated from the second radials, on the outer face, by a gaping suture, but immediately within, a straight ridge extends from one outer angle to the other having a furrow on each side so as to form a hinge on which the second plates articulate; behind this hinge in the middle part of each plate, there is a socket for the reception of a tooth-like projection. Second radials short and heavy and produced externally in a moderately strong spine.

First azygous plate longer than wide, pentagonal, upper side short, abutting below on a subradial and resting very slightly oblique between another subradial and the under sloping side of the first radial on the right. Second azygous plate longer than wide, truncates a subradial, abuts upon the superior lateral side of the first radial on the left, and the first and third azygous plates on the right. Third azygous plates longer than wide, truncates the first azygous plate, and abuts upon the superior lateral side of the first radial on the right. The second and third azygous plates are hexagonal, but the plates abutting the superior side are not preserved in our specimens. A small part of a proboscis is preserved in one of our specimens, that shows some heavy, transversely furrowed plates. Other parts not preserved.

This species is so different from any other referred to this genus, that no comparison will serve further to distinguish it. There is a possibility that it is a *Zeacrinus*, but we think it is not.

Found in the Upper Coal Measures, at Kansas City, Missouri, and now in the collection of Wm. F. E. Gurley.

HYDREIONOCRINUS NODULIFERUS, n. sp.

Plate VI, Fig. 15, view opposite the azygous area; Fig. 16, azygous view of the same specimen; Fig. 17, basal view of the same, showing the protruding part of the second radials.

Calyx bowl-shaped, twice as wide as high; columnar cavity abrupt; plate gently convex; sutures slightly beveled; surface granular. Column round.

Basals sunken in the columnar cavity and only slightly larger than the diameter of the column. Subradials of moderate size, four of them apparently pentagonal but really hexagonal, because of abutting two basal plates, one of them heptagonal, by reason of being truncated by the second azygous plate. The lower ends curve abruptly into the columnar cavity and the superior ends more gently upward toward the acute angles between the first radials. First radials one-third wider than high, truncated the entire width above, thickened within and separated from the second radials, on the outer face, by a gaping suture, but immediately within, a straight ridge extends from one outer angle to the other, having a furrow on each side, so as to form a hinge, on which the second plate articulates. Second radials of three kinds; the one opposite the azyous area is twice as long as wide, rounded externally, contracted in the middle, serrated or bearing small nodes at the lower end, where it projects beyond the first radial, and axillary at the superior end, where it bears two arms. The plates on each side of the azygous area are of the same form but shorter and project farther beyond the first radials, where the nodes are stronger, and the central one almost spine-like. The two lateral second radials are still shorter, having a width and depth, each, greater than the length, and projecting still more beyond the first radials, showing a remarkably wide gaping suture. The central nodes are really small spines. Each second radial bears upon the upper sloping sides two arms which make ten arms in this species.

The arms are composed of a single series of rather long plates, each one of which bears a central tubercle or node.

The first azygous plate is quadrangular and rests between a subradial and the under sloping side of the first radial on the right. It does not appear to abut upon a subradial below, but comes to a point near the angle. The second azygous plate truncates a subradial and rests between the superior lateral side of the first radial on the left and the upper sloping side of the first azygous plate on the right. The third azygous plate truncates the first and abuts against the very short lateral side of the first radial on the right. The second radials and the arms are quite different from anything heretofore described and will serve to distinguish it from all other species. Possibly, it may belong to *Zeacrinus*, though it has no close resemblance to any species described, in that genus. The summit of the proboscis will determine whether it belongs to *Hydreionocrinus* or *Zeacrinus*.

Found in the Upper Coal Measures, at Kansas City, Missouri, and now in the collection of Wm. F. E. Gurley.

HYDREIONOCRINUS CRASSIDISCUS, n. sp.

Plate VI, Fig. 18, basal view; Fig. 19, azygous side view of the calyx.

Calyx discoid, slightly concave below, plates convex; sutures distinct, surface granular. Column round.

Basals form a pentagon one-third wider than the columnar cicatrix, which is concave and radiately furrowed, for the support of the attaching column. Columnar canal very small. Subradials directed horizontally, convex, of unequal size, the one on the right of the azygous area being the larger and wider one; each one is hexagonal. First radials twice as wide as long, convex, sutures depressed, directed almost horizontally, so as to give the calyx a height little if any more than the thickness of the plates; separated, on the outer face, from the second radials, by a gaping suture, but immediately within, a straight ridge extends from one outer angle to the other, having a furrow on the outside and depression on the inside so as to form a hinge on which the second radial plates articulate. Second radials not preserved in our specimen.

First azygous plate quadrangular, longer than wide, resting between a subradial and the first radial on the left, and the under sloping side of the first radial on the right. The lower end does not reach the second subradial, as is usual in this genus. Second azygous plate longer than wide, truncates the first azygous plate, and separates the superior lateral sides of the two adjoining first radials. The third azygous plate barely touches a first radial.

Other parts of this species unknown, but the calyx is so different from any other described species that no comparison is necessary to distinguish it.

Found in the Upper Coal Measures, at Kansas City, Missouri, and now in the collection of Wm. F. E. Gurley.

HYDREIONOCRINUS GRANULIFERUS, n. sp.

Plate VI, Fig. 20, azygous side view of calyx and one second radial; Fig. 21, basal view of same specimen.

Calyx bowl-shaped, about twice as wide as high, concave at the azygous area, columnar cavity abruptly depressed, sutures distinct; surface very granular; column round.

Basals sunken and nearly covered by the column. Subradials curved abruptly into the columnar depression and almost as rapidly up toward the acute angles, that extend high between the first radials; three hexagonal, the other two heptagonal; all the angles are depressed, as in *Barycrinus.* First radials twice as wide as high, truncated the entire width above, much thickened within, and separated from the second radials, on the outer face, by a gaping suture, but immediately within, a straight ridge extends, from one outer angle to the other, having a furrow on each side, so as to form a hinge, on which the second radials articulate; behind the inner furrow, in the middle part of each plate, there is a notch for the arm furrow, and immediately in front of the notch there is a node that seems to have been for a socket in the succeeding plate. Second radials nearly twice as wide as high, concave in the middle, pentagonal, axillary and supporting on the upper sloping sides the free arms.

First azygous plate twice as long as wide, pentagonal, abutting below against a subradial, and resting obliquely between another subradial and the under side of the first radial on the right. Second azygous plate twice as long as wide, truncates a subradial and abuts upon the superior lateral side of the first radial on the left, and the first and third azygous plates on the right. Third azygous plate about as long as wide, truncates the first azygous plate and abuts upon the short superior, lateral side of the first radial on the right.

The arms and proboscis are not preserved, but there is little doubt about the generic reference, and the species is so marked, that it is unnecessary to compare it with any other for the purpose of distinguishing it.

Found in the Upper Coal Measures, at Kansas City, Missouri, and now in the collection of Wm. F. E. Gurley.

FAMILY DICHOCRINIDÆ.

TALAROCRINUS TRIJUGIS, n. sp.

Plate III, Fig. 9, basal view; Fig. 10, summit view; Fig. 11, view opposite the azygous side.

General form of the calyx and vault subelliptical. Calyx globose, truncated below; plates convex; sutures depressed; surface smooth.

Basals pentagonal and forming a very low cup or disc, one-fourth the height of the calyx, with a subelliptical columnar depression having a small circular facet for the articulating end of the column. First radials large, convex, as wide as high, four are nearly of the same form and rest on straight edges of the basals, while the other one rests in the obtuse angle formed at the union of the two basals, the summit supports two very short, double, second radials, in the middle two-thirds of its width, and one side of an interradial, on each, slightly oblique, superior, lateral edge. There are two double arm openings to the vault over each first radial plate, or one double arm opening over each short double second radial. Hence there are four arm openings to each radial or twenty small arms in the species.

A small, regular interradial rests between the superior lateral sides of the first radials and separates the short second radials and unites with the plates of the vault. The first azygous plate is in line with the first radials, it is larger and longer and extends above the top of the first radials. It supports a range of three plates, as near as can be ascertained from our specimen, which are followed by plates of about the same size to the azygous opening at the top of the vault.

The vault is elevated at the arm openings and sharply depressed at the interradial spaces. The arm openings are directed obliquely downward. The summit of the vault is convex with three elevated subspinous plates in the center, and otherwise covered with polygonal, convex and spinous plates. A spinous plate is over the line that separates the double arm opening in each of the five radial series. The azygous opening is near the margin.

This species is the same mentioned in Volume V, page 537, of the Geological Survey of Illinois, under the name of "Dichocrinus cornigerus, Schumard?" and the calyx of which is figured, under that name on plate 20, Fig. 6a, 6b, and 6c. The calyces of the two species, though somewhat different, resemble each other, but the resemblance disappears when the calyx and vault are found together. In *T. cornigerus*, the vault is much larger than the calyx and constructed on a different plan from the vault in this species so that the vaults could not be mistaken for each other, in any case. In this species the calyx is larger than the vault, and the depressed interradial spaces and prolonged radial areas are peculiar. The azygous areas have little resemblance in the two species.

Found in the St. Louis Group, at Rose Claire, in Hardin county, Illinois, and now in the collection of Wm. F. E. Gurley.

FAMILY TAX~~I~~OCRINIDÆ.

FORBESOCRINUS PYRIFORMIS, n. sp.

Plate IV, Fig. 1, view of an almost entire specimen.

General form of the calyx and arms, together, subovate or somewhat pear-shaped, which suggested the specific name. The column is round, large and tapers rapidly from the calyx, where it is composed of very thin plates.

The calyx constitutes more than half the length of the body, it is wider than high and somewhat obconoidal or funnel-shaped above the column. The plates are convex. The interradial areas are long and narrow, slightly flattened and depressed below the radial series, which are gently rounded.

Basal plates not observed. Subradials rather small. Primary radials twice as wide as high, convex on the outer face, pentagonal, hexagonal, or heptagonal, depending upon the number of interradials that abut upon them laterally; four in each of four series and only three in one of the lateral series; concave on the upper sides, immediately below which, they are most protuberant. The upper plates slightly overlap the next lower ones, in the middle part, though not by a little toothlike projection, as in *Forbesocrinus agassizi*. This projection is described as a distinct plate and called a "small patelloid plate," by Hall, in the Geological Report of Iowa, vol. 1, pt. 2, p. 631, and we find that error, in respect to *F. agassizi*, transferred to the definition of the genus, in the "Revision of the Palæocrinoidea," by Wachsmuth & Springer, page 51, where they say "The sutures of the radial and arm plates strongly sinuate, and partly occupied by additional patelloid plates." The toothlike projection, in *Forbesocrinus agassizi*, is not a separate plate; there are no patelloid plates in any species of *Forbesocrinus*, and it is not too much to say, they have no existence, in any known species of the Palæocrinoidea. They did not belong to the economy of that order of animals.

There are three secondary radials in each series, each one is twice as wide as high, and, though hexagonal, and heptagonal, and of the same general form, as the first radials, they are much smaller. The upper concave faces of the third secondary radials incline less, from the central apex, than they do in the axillary plates of the primary radials. The tertiary radials vary in number, from five to nine, in the different series, they are thinner and proportionally wider than either of the lower series, and being located, at the greatest circumference of the body, they are arranged transversely, instead of being inclined to the right and left, as in the primary and secondary series. The next division takes place, in one-half of the rays, from the seventh to the tenth plate, but no division is shown to take place, in our specimen in the other half of the rays, notwithstanding one of them is preserved as far as the sixteenth plate. In the higher rays, the plates are thin and transversely arranged, but the upper face of each one is moderately concave, and, in the middle part, slightly overlapped by a projection from the next succeeding plate, as in the primary and secondary series. The transverse, arcuate sutures are distinct and the slight overlapping does not destroy the depression, but, on the contrary, it is correspondingly depressed. There are, in the upper part, therefore, sixty arms.

The interradial areas are not of exactly the same shape, nor are they filled with exactly the same number of plates, though they have elongated, subovate, or lance-subovate outlines, pointed above. There are from eighteen to twenty-five plates, in each regular interradial area, but, on account of an injury to our specimen, at the azygous interradius, the number of plates in that area cannot be counted. The first regular interradial plate rests between the upper sloping sides of the first primary radials; in some areas it is followed by one plate, and in other areas, two plates abut against it; in one area, it is as large as any of the succeeding plates, while in other areas, there are from one to four larger plates above it; in the widest part of one of the areas, there are only two rows of plates, while in the others there are three. The plates, however, become smaller toward the top of each interradius. The intersecondary areas are of the same general form as the interradial areas, but much smaller, and contain from eight to twelve plates. In the intertertiary areas there are two or three small plates in line, one above another.

This species is distinguished from others, by its general form, comparative length of the calyx, structure of the rays and the interradial areas.

Found in the Keokuk Group, at Muldrough's Hill, Hardin County, Kentucky, and now in the private collection of Wm. F. E. Gurley.

TAXOCRINUS CRAWFORDSVILLENSIS, n. sp.

Plate IV, Fig. 3, lateral view of calyx, arms and part of the column.

This species so much resembles what we suppose to be *Forbesocrinus multibrachiatus* of Lyon & Casseday, that we will follow the definition of their species, as near as practicable, in order that the distinguishing differences, if they are of specific importance, may be made more prominent. *F. multibrachiatus* was not illustrated by the authors, and, as they may have included more than one species in their definition, exactly what was described may be somewhat doubtful. They were both good palæontologists and their descriptions, generally, were unexceptionable, but in this case, they gave Clear Creek, Hardin County, Kentucky, Washington County and Montgomery County, Indiana, as the typical localities for their species, and as we are quite sure no single species of *Forbesocrinus* or *Taxocrinus* was ever found at the three localities, we are left in doubt, as to what should be included under their specific name. White described a form, as *T. multibrachiatus var. colletti*, from Crawfordsville, which is certainly distinct from *F. multibrachiatus*, and, we think, it should be raised to the rank of a species, under the name of *T. colletti.* The difference between the genera *Forbesocrinus* and *Taxocrinus* are so poorly marked that it is not easy to say to which genus such species as we have here under consideration really belong, though we are inclined to think that our species should be referred to *Taxocrinus*, on account of its azygous area. Otherwise, we would refer it to *Forbesocrinus*.

In describing their species they say "Body subglobose where the arms are folded inward". This applies as well to our species. They say "From the base to the free arms somewhat discoid"; this we do not understand, because we do not suppose the arms become free until they passed the interradial plates, and we think their species agreed with ours in this respect. They say "Robust, externally covered with minute granules. Basal pieces three, similar in form and size, forming by their outer margins apparently the upper joint of the column, slightly thickened opposite the middle of the pieces. Subradial pieces five, in good specimens presenting five obtusely angular pieces disconnected with each other, resting apparently upon the supra-columnar piece." All these parts are not visible in our specimen, but, if we understand them correctly, the two species may agree in these respects.

They say "Radial pieces, first series, generally, four in each ray, the first five resting between the angular points of the subradials are regular in size and form, four are irregular hexagonal, twice as wide as high, the fifth pentagonal and much smaller than either of the others. The second and third radials are obscurely hexagonal, similar in form, differing slightly in size; the fourth is axillary, obscurely six-sided, rising into a long, angular point; on each of its oblique upper sides supporting three pieces of the secondary radials, which are similar in form and nearly as large as the first radials". Much of this will apply to our species, but we think the three secondary radials in each series, in our species, are much smaller than the primary radials.

They say "The last of these being axillary support on their upper oblique margins from four to seven brachial pieces." In our specimen the ray on the left and the ray on the right of the azygous area have each eight of these brachial pieces, and another ray shown on the right side of the illustration has ten, and another on the left of the illustration has ten. And from this part to the end of the arms the number of plates do not agree in the two species, though there are sixty arms in each species.

In their species there are fifteen regular interradials, as follows: One, followed by two in the second range and three in the third range, above which there are only two in each range or 5x2. In our specimen, in the only regular interradial area in which the plates can be counted, there are eighteen, as follows: One, followed by two in the second range and three in each of the next four ranges, above which three plates may be seen. We have an impression, however, that the number of plates in the interradial areas is not uniform.

In their species there are from six to seven secondary interradials and from three to five tertiary interradials. In our species there are from five to seven secondary interradials, but no tertiary interradials.

In their species there are six azygous plates in the order of one, two, one, two. In our species the azygous area is larger than the regular interradial areas and has a series of five long longitudinally convex plates, in the middle of the area, resting upon the truncated upper side of a basal plate, and extending as high as the third secondary radial, and, on each side of this ridge of plates there are several smaller polygonal plates, and others extending beyond. There is, therefore, no resemblance between the azygous areas in the two species.

The radial plates, in both species, as is usual in this genus, are concave on the exterior part of the upper sides and slightly overlapped, in the concave part, by the succeeding plates.

Their species, therefore, would seem to be more globose than ours, by reason of the wider secondary radials and presence of intertertiary radials. Our species has more tertiary radials than theirs, differs in the number and position of the regular interradials, and is so widely different, in the azygous area, that it alone will distinguish the species.

We have never seen a specimen, which we knew belonged to *F. multibrachiatus*, and we suppose it is because their type came from Clear Creek, Hardin County, Kentucky, and there has been error in referring other species to it.

Found in the Keokuk Group, at Crawfordsville, Indiana, and now in the collection of Wm. F. E. Gurley.

ONYCHOCRINUS PARVUS, n. sp.

Plate IV, Fig. 5, azygous side view.

Species very small. Calyx rather high, basin shaped; plates smooth; sutures distinct. Column round and composed of moderately long plates near the calyx.

Basals extend beyond the column, but our specimen is injured at the basals so the exact outlines are not shown. Subradials about half as large as the first radials and nearly as long as wide. One of them is concave on the upper face for the reception of a small azygous plate. The first radials are wider than long and truncated more than half the width for the second plate, which is the first plate in the free arms. The arms bifurcate on the third plate (or the fourth in the radial series). The arms are round externally and the plates more than half as long as wide; sutures transverse. The first armlet is thrown off from the second plate after the first bifurcation. Only a single azygous plate is preserved in our specimen and it is slightly out of place. No regular interradials are preserved.

This species is so much smaller than any heretofore described that no comparison with any of them is necessary to distinguish it.

Found in the Kaskaskia Group, at Shoals, in Martin county, Indiana, and now in the collection of Wm. F. E. Gurley.

FAMILY EUCALYPTOCRINIDÆ.

EUCALYPTOCRINUS WORTHENI, n. sp.

Plate IV, Fig. 2, lateral view.

The arms in the specimen illustrated are drawn away from the summit about half an inch, which gives them a bushy or broom-like aspect; if they were replaced between the interbrachial plates and closed, at the top, the general form of the body would be ellipsoidal.

Body medium size, with arms and interbrachials in place ellipsoidal in outline; surface of the plates granular.

Calyx a little more than one-third the entire length of the body, bowl or urn-shaped, wider than long; sutures distinct. Column round, medium size. Basals developed in the interior.

First radials rather large, rapidly expanding, and one-third wider than high. Second radials nearly square, being only a little wider than high. Third radials rather larger than the second, heptagonal, greatest width at the union of the superior and inferior sloping sides. First secondary radials pentagonal, about two-thirds as large as the third primary radials. Second secondary radials, short, about one-third as large as the second, expand upward, somewhat like an inverted frustum, and support the tertiary radials upon the upper slightly sloping sides. There are three short quadrangular tertiary radials below the summit of the interradials, and then the free arms commence with one or two cuneiform plates followed by interlocking ones, which maintain a somewhat uniform size, until they taper at the summit, where the solid interbrachials unite around the orifice. The arms being thrown out from between the interbrachials, in our specimen, probably, causes them to appear larger than they would if they were in place. They are somewhat crystalline and the sutures are more or less obliterated, and, therefore, the interlocking plates may be indicated, in the illustration, rather larger than they should be, but if so it is very little.

The first interradial is a large ten-sided plate, quite as large as the second and third primary radials together, and slightly longer than wide. It is followed by two long narrow plates that extend to the top of the third tertiary radials. The intersecondary radials are single, truncate the third primary radials, have the form of the two small interradials when united, but smaller than the two together. The solid interbrachials are rather thick below and gradually become thinner in their upward extension and unite at the summit, with each other and with the small plates that surround the orifice.

This species is distinguished from others by its general form, and when compared with *E. crassus*, which it may be said to most resemble, the calyx is proportionally much shorter, and more uniformly rounded and bowl-like, and the tertiary and secondary radials are wholly different in form and in position.

Found by Prof. A. H. Worthen, in the Niagara Group, in Wayne county, Tennessee, and now in the State Museum, at Springfield, Illinois. The specific name is in memory of the late distinguished State Geologist of Illinois.

FAMILY RHODOCRINIDÆ.

GONIASTEROIDOCRINUS LYONANUS, n. sp.

Plate IV. Fig. 4, view of the vault and lateral prolongations.

This species is founded upon the vault and lateral prolongations of the specimen illustrated. It is quite different from anything heretofore described or illustrated, and, therefore, deserves illustration and definition. Whether or not one is justified in giving a specific name to such a fragment is a question not so readily answered. A specific name should not be an obstacle in the way of progress, in palæontological learning. It requires neither information nor study to propose specific names, and when improvidently or unjustifiably proposed, they should not be recognized. We think, as a general rule, a specific name should never be given to a specimen, when, from its definition, another who may happen to find a better specimen, in rocks of the same age, cannot determine whether or not it belongs to the same species. We have here, however, a very complete part of the body of a peculiar crinoid, about the generic relations of which there is no doubt, and, we suppose, whenever the calyx is found, after our definition of this part, that one may readily determine that it belongs to this species, and it is for that reason we have felt warranted in giving to it a specific name.

Species rather small. Vault composed of small polygonal plates. Central part of the vault only slightly raised above the lateral margin and composed of the larger plates. Instead of a single proboscis arising from the center of the vault, as in many palæozoic genera, there are six lateral prolongations, five of which bifurcate, and one tapers to a point without a bifurcation. There is a shallow, subovate depression, within the margin, opposite each one of the five bifurcating lateral prolongations, but none opposite the single prolongation. Within one of these depressions, near the center of the vault, there is a small orifice surrounded with small plates—the anal opening of some authors, and the mouth of others. Beneath the plates of the vault there are channels passing between the depressions, meeting centrally, and connecting with each of the prolongations; two small channels enter the bifurcating prolongations, but only one is extended through the single branches, and it does not open externally. It will be observed, that the marginal plates of the vault are continued upon the lateral sides of the bifurcations, except in the case of the single prolongation, and it is evident the marginal circulation entered these prolongations, and also connected with the central circulation, through the channels above referred to. The functions performed by these lateral prolongations are, therefore, not essentially different from those performed by the proboscis in other genera. There is a slight elevation, within the margin, opposite the single prolongation, and from this point only a single channel seems to have entered the prolongation or unyoked feature of this vault. The arms connected with the body immediately below the rim of the vault, and some of the fragments of the arms are preserved on our specimen, though not illustrated. They are small and composed of a double series of interlocking plates bearing small pinnules.

This species is distinguished from others known to the authors by the spreading of the bifurcating prolongations, instead of their curving around, so as to cross each other, and by the single extension which is not known, by us, to exist in any other species. It is so different from the type of this genus, and from all defined species from rocks of the same age, that no comparison with any of them is necessary.

Found in the Keokuk Group, on Indian Creek, near Crawfordsville, Indiana, and now in the collection of Wm. F. E. Gurley. The specific name is in honor of one of the authors of the genus, the late distinguished palæontologist, Sidney S. Lyon.

FAMILY EUPACHYCRINIDÆ.

ULOCRINUS BLAIRI, n. sp.

Plate V, Fig. 16, azygous view; Fig. 17, basal view, Fig. 16, view opposite the azygous area.

This is the largest known species in this genus. The calyx has a height of nine-tenths of an inch and a diameter of one and seven-tenth inches, being nearly twice as wide as high. The base is very gently rounded to the middle of the subradials, above which the calyx is almost cylindrical. There is no columnar depression; the plates are plain, and slightly beveled at the sutures; surface granular.

The basals form a large, very gently convex, pentagonal disc, three times as wide as the diameter of the column. The column is round, and there is an impressed cicatrix, in the basal plates, where the column is attached, by radiate denticulations, near its outer circumference. Columnar canal, pentagonal, and having the ends of the rays rounded. Subradials about as large as all the basals together, a little wider than high, but if the plates were straightened the width and length would be about equal. Four of them hexagonal, by reason of uniting with two basals, where the angle is obtuse, the other one, which supports the second azygous plate, heptagonal. They rapidly curve upward in the middle part and extend an angle upward one-third the height of the first radials. First radials pentagonal, about one-half wider than high; the superior face is the full width of the plates, and extends internally about one-fourth the diameter of the calyx. The sutures are gaping, but, immediately within, a straight and furrowed ridge extends from one angle of the plates to the other, so as to form a ridge on which the second radials articulate.

The first azygous plate is quadrangular and rests obliquely between a subradial and the under sloping side of the first radial, and abuts the lower side against another subradial, and the superior side against the second azygous plate. Second azygous plate is more than half as large as the first, truncates a subradial and rests an under sloping side against the first azygous plate and separates two first radials. Other parts unknown.

This species is so different from either of the others that have been described that no comparison with any of them is necessary to distinguish it.

Found by R. A. Blair, in the Upper Coal Measures, near the line of Kansas and Missouri, southwest of Sedalia, and now in the collection of S. A. Miller.

ULOCRINUS OCCIDENTALIS, n. sp.

Plate VI, Fig. 6, view of the basal plates, part of two being broken away; Fig. 7, interior view of the same specimen; Fig. 8, a subradial plate.

The calyx of this species is broadly rounded, at the base, without a columnar depression, gradually expands beyond the subradials, and has a length greater than the diameter. The sutures are distinct, plates moderately thick, and peculiarly denticulate, at the sides, to strengthen their union with each other; surface granular. The column is round, and there is an impressed cicatrix, in the basal plates, where the column is attached, by radiate denticulations, near its outer circumference. Columnar canal pentagonal.

Basals form a cup about one-third as high as wide. The plates are longer than wide and gently curve upward from the columnar facet. The most remarkable curiosity is their prolongation, in the interior of the calyx. They project up, in the interior, in the form of a five-furrowed, gradually expanding, thin cup, for the distance of about one-sixteenth of an inch. The columnar canal is thus expanded or enlarged within the cavity of the body, and extraordinary solid parts are developed, for muscular attachment, and to give strength to this part of the body. The length and breadth of a subradial is about equal; it is convex and gradually expands to the superior lateral angles. Other parts of this species unknown.

What we have of this species is so different from others that have been described, that no comparison is necessary to distinguish it.

Found in the Upper Coal Measures, at Gilpin, Missouri, and now in the collection of Wm. F. E. Gurley.

ÆSIOCRINUS ANGULATUS, n. sp.

Plate VI, Fig. 9, view of calyx and part of an arm and three azygous plates. The specimen is a little depressed.

Calyx bowl-shaped, twice as wide as high; broadly truncated, below; plates tumid and angular; sutures deep, most depressed at the angles; surface granular. Column round or subelliptical and the end slightly inserted in the basal plates and attached by radiating denticulations near the outer circumference. Columnar canal very small and round.

The basals form a flat, pentagonal disc about one-half wider than the diameter of the column. Subradials large; four hexagonal, one heptagonal, directed nearly horizontally from the basals so as to form a pentagonal disc around the basals. The plates are subpyramidal and angular, with the apex directed downward so as to leave about half of the plates below the level of the basal plates, and if the calyx is made to stand upon a plain, it will rest upon the apices of the subradials. The superior angles of the subradials are deeply sunken, as is usual in *Barycrinus*. The first radials are thick, heavy plates, about twice as wide as high, truncated nearly the entire width above and having the facets inclined outward at an angle of about forty-five degrees. They are convex, with a transverse obscure ridge in the central part and beveled toward the sutures. The superior face has a transverse ridge and narrow furrow near the outer margin and a broader furrow on the inside of the ridge; the inner central part is notched for an arm furrow. The superior face has the appearance of supporting a single plate, but in the part of one of the rays which is preserved, we see it supports a central axillary plate occupying about one-third of its width, and a plate on each side of the axillary plate occupying the outer part of it. Each of the lateral plates supports two interlocking plates that have an arm furrow on the inside, which indicates that there are two arms to each ray, or ten arms in the species, and that the two arm furrows unite within the axillary, second radial, so as to connect with the interior of the calyx, through the single notch or arm furrow in the first radial. A rather long, convex, azygous plate truncates a subradial and extends as high as the top of the first radials, where it is followed by two convex plates of about equal size, that articulated with the other plates.

This species differs so from other species of *Æsiocrinus* that it is with some hesitation we refer it to that genus, though the general structure of the calyx, aside from the sculpturing of the plates and sunken sutures, agrees more nearly with that genus than with any other that has been defined.

Found in the Upper Coal Measures, at Kansas City, Missouri, and now in the collection of Wm. F. E. Gurley.

EUPACHYCRINUS PARVUS, n. sp.

Plate VI, Fig. 22, basal view of calyx; Fig. 23, azygous side view.

This is the smallest known species, in this genus, and differs, in every particular, from all of them, except in the number and relative position of the plates of the calyx. Calyx very low, more than twice as wide as high; subpentagonal in outline, columnar cavity embracing the basals and nearly half of the subradials; sutures distinct and sunken at the angles; surface smooth.

Basal plates about one-half wider than the diameter of the column; citatrix for the columnar attachment concave, radiately furrowed, and pierced by a very small pentagonal columnar canal. Subradials the larger plates of the calyx, though not of uniform size, the one on the right of the azygous side being the larger. They abruptly bend down into the columnar cavity, where each bears one or two concave furrows as if gouged out with a small circular chisel, and abruptly curve upward and reach nearly to the top of the calyx. They are convex, externally, and the sutures are depressed, the depression being most marked at the angles. First radials twice as wide as high, pentagonal, the lower angle extending nearly to the bottom of the calyx, truncated the entire width above, and much thickened within; sutures gaping, but immediately within, a straight ridge extends from one outer angle of the plates to the other, so as to form a hinge on which the second radials articulate.

Azygous plates small, quadrangular and inserted between a subradial and the under sloping side of the first radial, on the right, and abutting another subradial. It is followed by another plate, as indicated by the notch between it and the top of the first radial on the left.

Found in the Upper Coal Measures, at Kansas City, Missouri, and now in the collection of Wm. F. E. Gurley.

ORDER BLASTOIDEA.

FAMILY **NUCLEOCRINIDÆ.**

NUCLEOCRINUS GREENEI, n. sp.

Plate VI, Fig. 24, side view; Fig. 25, basal view.

Body elongate, subovoid, depressed in the interradial spaces, so that, viewed from either end, it presents a five-rayed outline, obtuse at the angles; most deeply pentalobate at the base, less deeply above; greater width above the middle.

Base concave; basal plates very small and sunken below the radials. Radial plates very short, embracing the base of the pseudambulacral fields, which consists of a node in the central part of each plate. Pseudambulacral fields very narrow. Interradials extend to the summit and are centrally depressed in lanceolate outline, but no suture is discovered, by the side of this lanceolate ornamentation. Azygous interradius wider than the regular areas, most deeply sunken at the base and becoming convex or more prominent near the summit of the azygous plate than the pseudambulacra. The azygous plate occupies the entire interradius at the union with the basal plates, it becomes gently narrower above and abuts upon the outer half of the azygous orifice. The interradial plate is very narrow on each side of the azygous plate, pointed at the lower part, and surrounding the azygous orifice above, it reaches the summit.

Found by G. K. Greene, in whose honor we have proposed the specific name, in the Upper Helderberg Group, at Louisville, Kentucky, and now in the collection of Wm. F. E. Gurley.

NUCLEOCRINUS VENUSTUS, n. sp.

Plate VI, Fig. 26, azygous side view; Fig. 27, summit view of same specimen from Louisville; Fig. 28, side view; Fig. 29, basal view of same; Fig. 30, side view of another specimen, all from Columbus, Ohio.

Body elongate, subelliptical, flattened or slightly concave in the interradial spaces, obtusely rounded at the pseudambulacra; greatest width about the middle.

Base nearly flat. Basal plates slightly convex. Radials rather long and embracing the lower end of the pseudambulacral fields, and the node, which terminates the pseudambulacra, in the central part of each plate. Pseudambulacral fields narrow, uniform, in width, and separated by a sharply angular depression. Interradials extend to the summit and are centrally depressed in lanceolate outline, but no suture has been discovered, by the side of this lanceolate ornamentation, to show that it is a plate, as described by Lyon, in the Geological Survey of Kentucky. Possibly the sutures are anchylosed. This lanceolate depression has a fine, longitudinal furrow, in the center. On each side of the lanceolate depression the surface is beautifully ornamented with longitudinal, crenulated lines.

Azygous interradius a little wider than the regular areas, and the azygous plate stands out prominently beyond the pseudambulacra toward the summit. The longitudinal, lanceolate depression on the azygous plate, that would seem to correspond with the lanceolate depression, in the regular areas, does not correspond with the outline of the azygous plate. On the contrary, the azygous plate is considerably larger and occupies fully two-thirds of the whole azygous interradius. The sides are beveled downward from the azygous opening to the suture line and the summit is notched for the orifice. The interradial plate in the azygous area is narrow on each side, pointed in the lower part, notched for the azygous orifice and reaches the summit. The surface is ornamented as in the regular areas.

There are two elongated apertures, at the summit of each pseudambulacra, which are indicated by a raised rim in the adjoining interradials. The central part of the summit is covered by numerous plates.

Figs. 26 and 27 represent a specimen from the Upper Helderberg Group, at Louisville, Kentucky, in the collection of Wm. F. E. Gurley; and Figs. 28 to 30, two specimens from the Upper Helderberg Group, at Columbus, Ohio, in the collection of S. A. Miller. Several other specimens have been examined and the forms from Columbus, Ohio, are somewhat rounder and a little more evenly elliptical than those from Louisville, but otherwise, they appear to be alike and we are disposed to refer them to the same species. It will be readily distinguished from *N. lucina* by the less pentalobate form, longer radial plates and different surface ornamentation. It is, in all its parts, a distinct species. It will be distinguished from *N. angularis*, by the narrower azygous interradius, and much less angular outline, when viewed from any direction, beside it is proportionally a much longer form.

FAMILY GRANATOCRINIDÆ.

GRANATOCRINUS SPHÆROIDALIS, n. sp.

Plate VI. Fig. 31, summit view; Fig. 32, basal view; Fig. 33, lateral view, but the artist overlooked the interradial sutures.

Body small, subsphæroidal, moderately sunken in the interradial areas, so as to give it a pentalobate aspect; greatest width, at the upper third, where the diameter is greater than the length; broadly truncated above and concave in the central part; truncated below, and, when placed on its base, will rest on the distal ends of the ambulacra; columnar facet large.

Basal plates small and extend only slightly beyond the column. Radials extend about two-thirds of the length of the body, with distinct lateral sutures. Regular interradials one-third the length of the body and strongly incurved above. Azygous interradial stands nearly upright, above the level of the summit of the other parts of the body, where it is pierced with the azygous orifice. Pseudambulacra very gently expand, from the base to the summit, and are distinctly convex above the thin margins of the radials on each side. Pore pieces about thirty-three on each side of a well defined mesial furrow, along which their inner ends are crenate and from which they are directed obliquely downward. Summit has a rather large central five-rayed opening. Ovarian apertures large and situated on each side of the point of each interradial piece, two of them extending to the azygous orifice.

Found in the Kaskaskia Group, in Meade County, Kentucky, and now in the collection of Wm. F. E. Gurley.

GRANATOCRINUS WINSLOWI, n. sp.

Plate VI, Fig. 34, side view; Fig. 35, basal view.

Body medium size, subspherical, depressed convex in the interradial areas, evenly rounded in the middle part, longer than wide, truncated very slightly at either end ; columnar facet small; surface sculptured and tubercular.

Basal plates form a large pentagon notched by the distal ends of the ambulacra. Radials extend less than half the length of the body and have strongly defined sutures. Regular interradials more than half the length of the body and incurved at the summit. A longitudinal line of tubercles ornaments the middle of each interradial to its lower extension, which is continued as a double row, or row on each side of the radial suture, to the basal plates, and on each side of these mesial tubercles, there are one or two shorter rows of tubercles. Pseudambulacra rather rapidly expand from the base to the summit and are depressed in their upward extension below the thickened and tubercular margins of the radial and interradial plates, though, at the lower end, their convexity rises higher than the margins of the radials. Pore pieces between fifty and sixty on each side of a mesial furrow, along which their inner ends are crenate, and from which, they are directed obliquely outward and downward. The summit and azygous interradial are so injured, in our specimen, that but little can be ascertained of their characters, the ovarian openings, however, are quite small, and we are not sure that there is any more than one to each interradial plate.

The specific name is given in honor of the late Dr. J. C. Winslow of Danville, Illinois, a personal friend of one of the authors and one of the "old time" collectors, to whose patience and zeal science has been very greatly indebted.

The specimen from which this description is drawn was found in the drift at Danville, Illinois, and is in the collection of Wm. F. E. Gurley. The supposition is that it came from rocks of the age of the Burlington Group, a short distance north of Danville, which are now deeply covered with the drift.

SUBKINGDOM CŒLENTERATA.

CLASS ANTHOZOA.

ORDER ZOANTHARIA RUGOSA.

FAMILY **CYATHOPHYLLIDÆ**.

CAMPOPHYLLUM KANSASENSE, n. sp.

Plate VII, Figs. 19 and 20, calyces; Figs. 21 and 22, lateral views.

Corallum simple, short, turbinate, irregularly curved, acute at the base, and irregularly distorted in growth. Epitheca thin, with minute encircling wrinkles, interrupted only by the distortions in growth, and showing no trace of septa or dissepiments where unabraded, but if slightly worn, both septa and dissepiments are exposed plainly to view. Calyx circular, moderately deep, margin thin, from which the sides gradually slope to near the bottom of the cup, where the septa curve to the central tabulæ, and the wall as abruptly thickens. No septal fossula. From twenty-four to forty septa extending from one-third to the entire distance from the outer wall to the center. Most of them terminate before reaching half the distance to the center, but a few are shown to reach to the center. Secondary septa quite marginal and best seen when the epitheca is eroded on the outside. The tabulæ, as seen in the central area of the calyx, are flat and smooth except where penetrated by the septa. The outer vesicular zone is thin and vesicles rather large.

Our specimens are only about an inch in length, and we think they represent a small turbinate species. The species evidently belong to this genus, from the vesicular outer zone, incomplete tabulæ and short septa, but it is widely separated from *C. torquium*, the only other form yet defined, from the Coal Measures of this country, not only in size and shape, but in the internal structure and form of the calyx.

Found in the Upper Coal Measures, at Kansas City, Missouri, and now in the collection of Wm. F. E. Gurley.

FAMILY **FAVOSITIDÆ.**

MICHELINIA BRANNERI, n. sp.

Plate VII, Fig. 12, side view; Fig. 13, summit view.

About half the length of our specimen is covered with an epitheca; transversely, it is somewhat elliptical and the summit is convex. However, we would infer, that the species is more or less globular, ovoid or elliptical, in the upper part, and has an irregularly convex summit. The lower part expands more or less from the base, or place of attachment to some foreign object, and is covered with a dense, transversely wrinkled epitheca. The corallites are polygonal and extremely variable in size, some are minute and others are very large; they open in all directions, and some parts of the corallum are more prominent than other parts, which produces an irregular summit. The calyces are deep, and the walls are thin, even where the wrinkled epitheca unites with the corallites, the margin is exceedingly thin.

This species is evidently related to *M. eugeneæ*, but we think it is a larger species and distinguished by having larger corallites, deeper calyces, more dense and strongly wrinkled epitheca and a larger base.

Found in the Coal Measures, at Danville, Illinois, and now in the collection of Wm. F. E. Gurley. The specific name is in honor of Prof. J. C. Branner, of Leland Stafford, Jr., University.

SUBKINGDOM MOLLUSCOIDA.

ORDER LYOPOMATA.

FAMILY LINGULIDÆ.

LINGULA INDIANENSIS, n. sp.

Plate VII, Fig. 1, ventral valve.

Subovate or nearly subelliptical in outline; greatest width below the middle; length nine-tenths of an inch, greatest width six-tenths of an inch, or one-half longer than wide. Apical end somewhat truncated, anterior extremity more uniformly rounded. Sides gently convex. Valves very moderately convex in the central part and flattened near the margins. Beaks not prominent. Color, light brown or yellowish brown.

Concentric striæ very fine near the beaks, and, therefore, in the younger stages of growth but becoming coarser and more distant and somewhat undulating toward the anterior end and lateral margins.

There is no described species from Subcarboniferous rocks having the general form of this one, and it would not throw any light upon it, to compare it with subovate or subelliptical forms from Silurian or Devonian rocks.

Found in the Keokuk Group, at Crawfordsville, Indiana, and now in the collection of Wm. F. E. Gurley.

FAMILY DISCINIDÆ.

DISCINA ILLINOISENSIS, n. sp.

Plate VII, Fig. 2, dorsal view; Fig. 3, interior of ventral valve; Fig. 4, dorsal valve oi another specimen; Fig. 5, interior of dorsal valve of another specimen.

Shell large, subcircular in marginal outline, or slightly oval, longitudinally; height nearly or quite equal to one-half the diameter. Apex prominent, acute, and situated centrally or slightly posterior to the central part of the shell, and moderately incurved. The sides slope rapidly from the apex for one-third the height of the shell and then more and more gently to the margin, though, on the anterior side the shell is more compressed toward the margin than it is on the posterior part.

Surface marked by irregular radiating lines or striations, and by strong concentric elevated lines. The striæ and elevated concentric lines become more and more conspicuous toward the margin. The lower valve shows a depression on the side of the foramen, but our specimen, as shown by figure 3, is somewhat broken and pressed out of shape. The concentric lines are strongly impressed upon it.

The two specimens shown by figures 2 and 3 are from the Coal Measures, in Knox county, Illinois, and the two specimens shown by figures 4 and 5 are from Peoria county, Illinois. We refer them all to the same species, though we look upon figure 2 as the best preserved and most typical. They are all in the collection of Wm. F. E. Gurley. Figure 5 shows the interior of the upper valve and where the shell is abraded the concentric lines are strongly marked in the stone.

This species is so far removed from *Discina nitida*, that no one would be enlightened by making a comparison with it. It is more nearly related to *Discina convexa*, described from the Upper Coal Measures, in the valley of the Verdigras river, in

Kansas, and not uncommon at Kansas City, Missouri. In *D. convexa* there is a shallow depression directly under the beak, on the posterior side, which is not manifest in this species. In *D. convexa* the beak is more obtuse, less incurved, and situated nearer the posterior margin, than it is in this species. The radiating lines that ornament the dorsal valve in this species have not been noticed in *D. convexa*, beside this species seems to be the smaller of the two.

DISCINA MUNDA, n. sp.

Plate VI, Fig. 6, dorsal view; Fig. 7, lateral view of the same valve.

Shell medium size, elliptical, height less than one-third the length. Dorsal valve most convex anterior to the beak and near the posterior third of the shell, from which part it slopes regularly to the lateral and anterior margins. Beak acute and situated almost directly above the posterior margin of the shell. The shell is concave from the point of the beak to the posterior margin.

Surface jet black and marked by fine concentric lines only just visible to the unaided eye.

We know of no species with which it is necessary to compare this one.

Found in the Upper Coal Measures at Kansas City, Missouri, and now in the collection of Wm. F. E. Gurley.

ORDER ARTHROPOMATA.

FAMILY **RHYNCHONELLIDÆ.**

EATONIA COULTERI, n. sp.

Plate VII, Fig. 8, ventral view; Fig. 9, dorsal view; Fig. 10, cardinal view; Fig. 11, front view.

Shell medium size, longitudinally ovoid, fully as wide as long and two-thirds as thick, gradually expanding from the beaks, at first, then more rapidly, and finally broadly rounded at the sides; truncated at the anterior end. Surface marked by fine, radiating, bifurcating striæ.

Ventral valve convex from the middle toward the beak, flattened toward the antero-lateral margins and then abruptly inflected at right angles; extended in a broad, shallow, undefined, mesial depression toward the front, where it is also abruptly inflected at right angles. Beak elevated and perforated. Dorsal valve convex in the middle part and sloping in all directions, most rapidly laterally and toward the antero-lateral margins. The central part slopes least toward the anterior margin, and appears as an undefined, elevated, rounded, mesial fold, abruptly inflected at the front. Beak incurved. Margins of the valves denticulated.

This cannot be mistaken for any other defined species.

The specific name is given in honor of Prof. John M. Coulter, President of Lake Forrest University.

Found in the Oriskany Group in Jackson County, Illinois, and now in the collection of Wm. F. E. Gurley.

CLASS PTEROPODA.

FAMILY **CONULARIIDÆ**.

CONULARIA BLAIRI, n. sp.

Plate VII, Fig. 14, part of the surface of the upper part of the shell; Fig. 15, a specimen showing a portion of the inside of a shell, the elevated ridge shows the depression of the angles.

Shell very large, pyramidal. Angles at the four corners deeply furrowed. Lateral surfaces marked with a longitudinal, mesial line, without any furrow. Surface ornamented with transverse, smooth furrows, that are separated by low, sharp, crenate, transverse costæ; in passing across the sides, these curve forward toward the aperture, and sometimes the costæ alternate at the mesial line, at other times they cross it with slight interruption. There are from twenty-one to twenty-four costæ, in a distance equal to the width of a side. The costæ curve forward toward the aperture, in crossing the furrows, at the four. corners. There are about eight crenulations, on the costæ in one-eighth of an inch, and about sixteen furrows in an inch, or about four crenulations in a distance equal to the width of a furrow, toward the apex; but nearer to the aperture there are six crenulations in a distance equal to the width of a furrow.

One side of a specimen, three and one-fourth inches long, has a diameter, at one end, of five-eights of an inch, and a diameter at the other end of one and six-eighths inches.

This is a large species and when compared with *C. gratiosa*, it will be noticed that the sides are less convex, the angles at the four corners deeper, and the furrows only half as wide.

Found by R. A. Blair, in whose honor the specific name is proposed, in the Chouteau limestone, at Sedalia, Missouri, and now in the collection of S. A. Miller.

CONULARIA GRATIOSA, n. sp.

Plate VIII, Fig. 1, showing two sides of a slightly compressed specimen.

Shell very large, rather rapidly expanding, from the apex, pyramidal and having subequal, lateral surfaces, which are slightly convex. Angles at the four corners moderately furrowed. Lateral surfaces marked with a longitudinal, mesial line, without any furrow. Surface ornamented with transverse, wide, smooth furrows, that are separated by sharp, prominent, crenate, transverse costæ; in passing across the sides, these curve forward toward the aperture, and sometimes the costæ alternate in the middle, and, at other times, cross the mesial line almost without interruption. There are from ten to thirteen costæ in a distance equal to the width of a side. The costæ are abruptly curved toward the aperture, in the furrows, at the four corners.

Our specimen is somewhat compressed, the four sides are quite well preserved and seem to be nearly complete at the larger end; it has a length of five inches, though one or two inches are broken away from the apical end.

This is a large and beautiful species, and will be distinguished by the convex sides, distant, crenulated, transverse costæ and wide, smooth furrows.

Found in the St. Louis Group, at Spergen Hill, Indiana, and now in the collection of Wm. F. E. Gurley.

CONULARIA SPERGENENSIS, n. sp.

Plate VIII, Fig. 2, view of a specimen, with both ends destroyed.

Shell very large, long, slowly expanding, at least, toward the larger end; subconical, and having, so far as can be observed, equal lateral surfaces. Angles at the four corners indicated by a slight, poorly defined furrow. Lateral surfaces marked with a longitudinal, mesial line, without any furrow. Surface ornamented with numerous, very small, closely crowded, transverse striæ of very nearly the same size, on all parts of the shell.

The striæ do not arch forward, in crossing the sides, as is usual in this genus, and they are not much interrupted in crossing the obscure corners or the mesial lines on the sides, indeed, it is not easy to determine from our specimen which is the forward end of it. The narrow furrows are crossed by fine lines or bars and the striæ are minutely crenate. There are about fifty transverse striæ in an inch in length.

Our specimen is more or less preserved, for five inches in length, but both ends are broken away so that no correct idea can be formed of the true length of the shell.

It is distinguished by its great length, rounded form, and surface ornamentation.

Found in the St. Louis Group, at Spergen Hill, Indiana, and now in the collection of Wm. F. E. Gurley.

CLASS CRUSTACEA.

ORDER TRILOBITA.

FAMILY **ILLÆNIDÆ.**

ILLÆNUS DANIELSI, n. sp.

Plate VII, Fig. 3, dorsal view of a magnesian limestone cast; Fig. 4, anterior view of same specimen; Fig. 5, pygidium of same,

Species, judging from our specimen, below medium size. Head short and much inrolled, length from the neck furrow to the anterior part, between the eyes, less than one-third the width. The head is abruptly bent inward from a line connecting the anterior part of the eyes. Glabella depressed convex, between the eyes, on top and re-curved in front. Dorsal furrows extend in almost parallel lines from the posterior part of the shield, to a shallow pit on the inner side of the anterior central part of each eye. Eyes large, distant, prominent and situated close to the posterior margin of the head. Palpebral lobe rounded. Facial suture extends from a point in the occipital furrow, behind the middle of the eye, inward to the posterior portion of the palpebral lobe, where it makes a rather sharp angle and then gently curves to the anterior part of the eye, then bends almost at right angles and then curves to the anterior margin, slightly within the line of the eye. Cheeks small, abruptly bent down and backward so as to extend, laterally, only a little beyond the outer lines of the eyes.

Thoracic segments ten, narrow; axis broad, depressed convex, full half the width of the animal, and a little wider at the anterior than at the posterior segment. On each side of the axis there is a flat space, about one-fourth the width of the lateral lobes, and then the pleuræ are bent gently backward.

Pygidium quite short, and, in outline, much like a double convex lens. It is not trilobate.

It is unnecessary to compare it with any other described species, for the purpose of distinguishing it.

Found in the Niagara Group, at Bonfield, near Kankakee, Illinois, and now in the collection of Wm. F. E. Gurley. The specific name is in honor of L. E. Daniels, of Mazon, Illinois, an active collector, who discovered the species.

FAMLY LICHIDÆ.

LICHAS HANOVERENSIS, n. sp.

Plate VIII, Fig. 6, front view of head; Fig. 7, dorsal view of head without cheeks.

Glabella divided into three lobes by straight, longitudinal lines. The middle lobe is exceedingly high and quite evenly convex, from its posterior extension to the anterior border. It is like a cylinder bent in the form of two-thirds of a circle and covered with large and small tubercles. The lateral lobes are quite small and look like little auricles on the side of the central lobe. The anterior border of the head is in the form of a very small rounded rim, depressed at the lines dividing the glabella. A broad, rounded, transverse depression separates the central lobe of the glabella from the neck furrow, and upon each side, behind the lateral lobes of the glabella a transverse, elliptical swelling extends to the inner side of the visual organs. Movable cheeks not preserved.

This species resembles *L. palmata* or *L. scabra*, figured by Barrande, more than any of the described American species.

Found in the Niagara Group at Hanover, Indiana, and now in the collection of Wm. F. E. Gurley.

LICHAS BYRNESANUS, n. sp.

Plate VIII, Fig. 8, front view of head; Fig. 9, dorsal view of the head without the cheeks.

The glabella is covered with tubercles and divided into three lobes by slightly diverging lines on the dorsal side, but parallel lines in the front. The middle lobe is extended longitudinally into an obtuse point in front, far beyond the lateral lobes. The dorsal side is straight and convex longitudinally; the front is high, convex and very gently rounded, from the obtuse point, back to the anterior border. The lateral lobes are somewhat reniform, wider than the central lobe, but much shorter. The anterior border of the head is in the form of a very small rounded rim, depressed at the lines dividing the glabella into three lobes. There is a rather deep, transverse sulcus at the posterior part of the three lobes of the glabella, behind which, posterior to the central lobe, there is a flattened or slightly concave area in front of the neck furrow and behind the lateral lobes of the glabella, there is a transverse elevation produced into a conical elevation, laterally, beyond the lateral lobes and which extends to the visual organs. Movable cheeks not preserved.

Found in the Niagara Group a few miles back of Madison, Indiana, and now in the collection of S. A. Miller. The specific name is in remembrance of the late distinguished naturalist, Dr. R. M. Byrnes.

FAMILY CERAURIDÆ.

CERAURUS MILLERANUS, n. sp.

Plate VIII, Fig. 10, a fine specimen.

General outline of the entire body exclusive of spines subovate, but abruptly narrowed at the pygidium; surface tubercular. Head exclusive of the spines, subelliptical, width nearly three times as great as the length. Neck furrow strongly marked. Glabella gently convex dorsally, narrower at the base than the width of the cheeks, but at the anterior third about as wide as the posterior part of the cheeks; more convex in front and abruptly bent down to the margin. There are three short lateral furrows exclusive of the neck furrow, dorsal furrow sharp, lateral lobes convex; forehead lobe short. The eyes are placed about the center of the cheeks, but most distant from the dorsal furrow. They are small, prominent, globose and smooth, or minutely facetted. The facial sutures anterior to the eyes make a sigmoidal curve to the margin, in front of the eyes, and posteriorly they curve a little backward and cut the margin about even with the neck furrow continued, cheeks bear a short thick posterior spine.

Thorax has ten segments. Axis moderately convex and nearly as wide as the lateral lobes; a little wider at the anterior than at the posterior segment. The lateral lobes are flattened on each side of the dorsal furrow for one-third or one-half the width and then the pleuræ curve backward and taper to a point. A line of mammillary tubercles on each lateral lobe indicates the point at which the pleuræ commence to curve backward.

Pygidium very short and much narrower than the body and bearing two short thick spines, that curve toward each so that the points are closer than the bases.

This species is distinguished from *C. pleurexanthemus* by having proportionally a shorter head, shorter and thicker cheek spines, wider forehead lobe of the glabella, wider and less convex thoracic axis and shorter and thicker spines to the pygidium which curve toward each other instead of spreading. This species has been, generally, confounded with *C. pleurexanthemus*, but a comparison of numerous fragments as well as entire specimens has shown the above mentioned variations to be constant. It was first pointed out as a distinct species, from an examination of the specimen illustrated, about twenty years ago, by Dr. C. A. Miller, now deceased, in whose memory we now dedicate the species.

Found in the Hudson River Group, at Cincinnati, and now in the collection of Wm. F. E. Gurley.

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Bulletin No. 3. Plate I.

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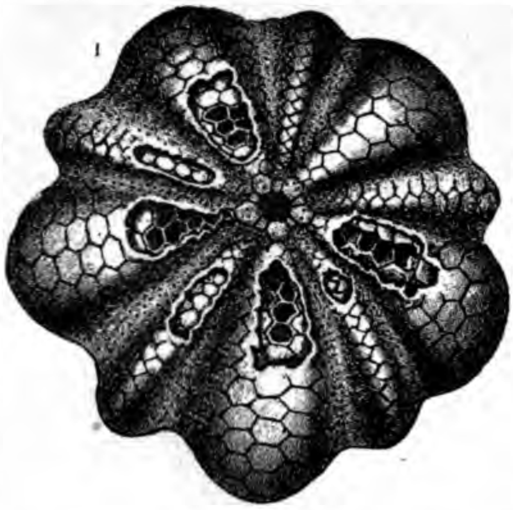

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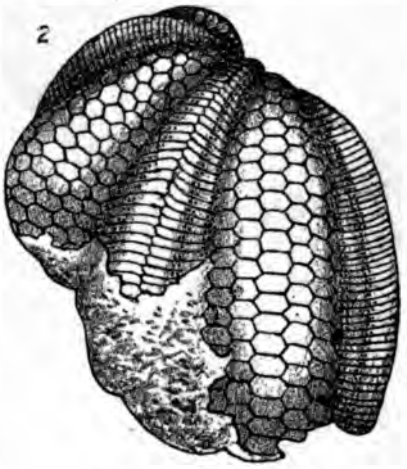

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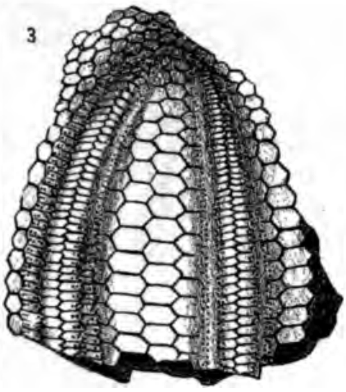

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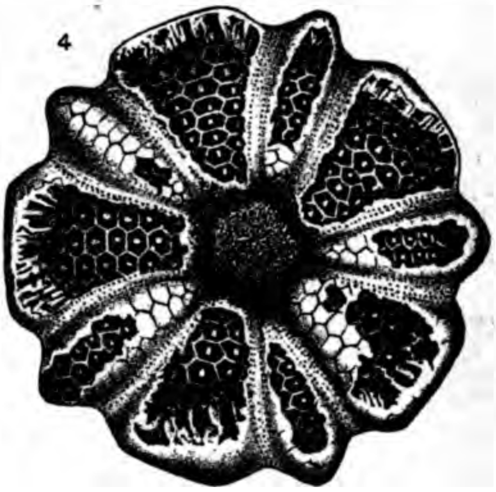

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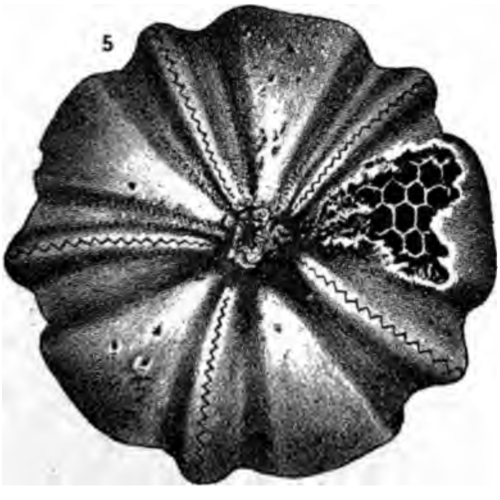

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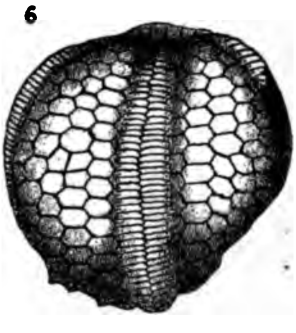

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PLATE I.

PAGE.

MELONITES INDIANENSIS, n. sp. 5

Fig. 1. Apical view.

OLIGOPORUS BLAIRI, n. sp. 6

Fig. 2. Upper part of a somewhat crushed example.

Fig 6. A smaller specimen showing part of ambulacral pores.

OLIGOPORUS BELLULUS, n. sp. 7

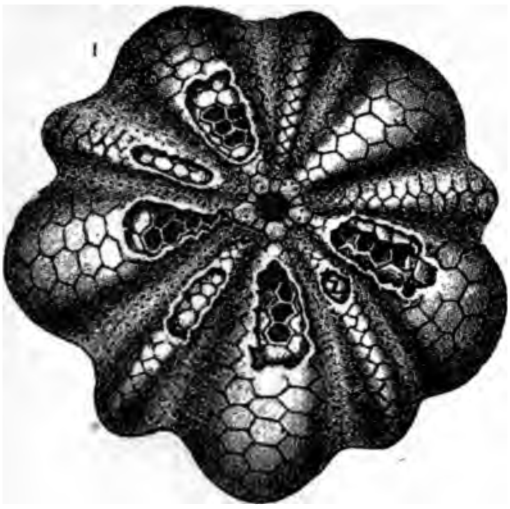
Fig. 3. Part of the upper half of a crushed specimen.

OLIGOPORUS SULCATUS, n. sp. 8

Fig. 4. Basal view.

Fig. 5. Apical view.

Plate I.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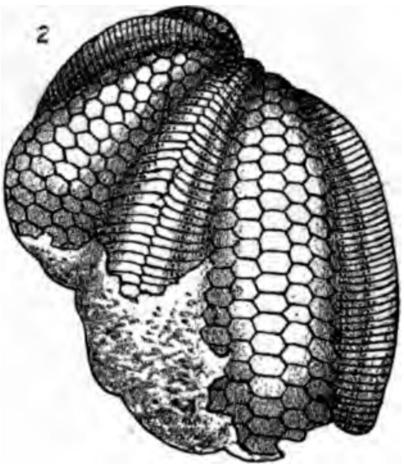
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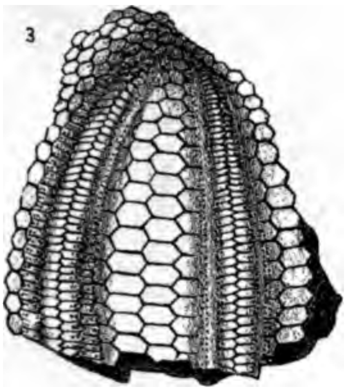
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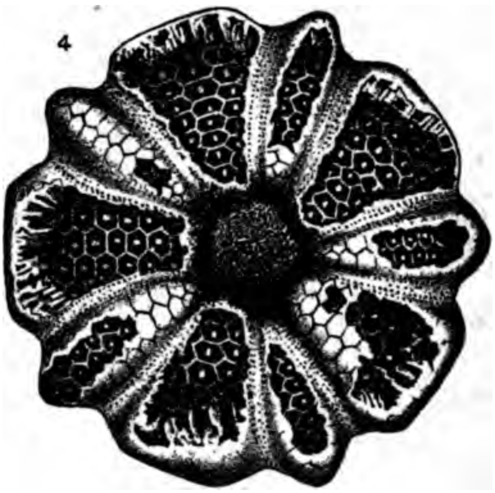
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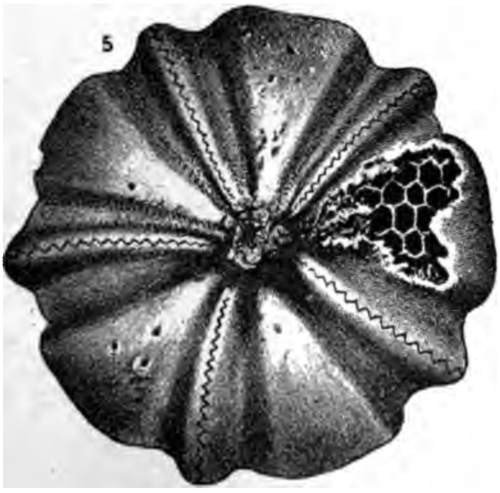
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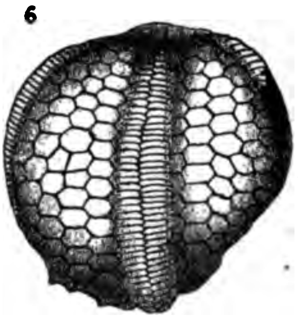

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PLATE II.

PAGE.

ACTINOCRINUS GIBSONI, n. sp.. 10
Fig. 1. Dorsal, or opposite view from the azygous side.

ACTINOCRINUS ERRATICUS, n. sp.. 14
Fig. 2. View opposite the azygous side.
Fig. 3. Azygous view.

ACTINOCRINUS ARROSUS, n. sp.. 15
Fig. 4. Side view of a somewhat flattened calyx.

ACTINOCRINUS PLAGOSUS, n. sp.. 16
Fig. 5. Azygous view of calyx.
Fig. 6. A crushed specimen showing the arms.

OLIGOPORUS BLAIRI, n. sp.. 6
Fig. 7. The middle part of a rather large and flattened specimen.

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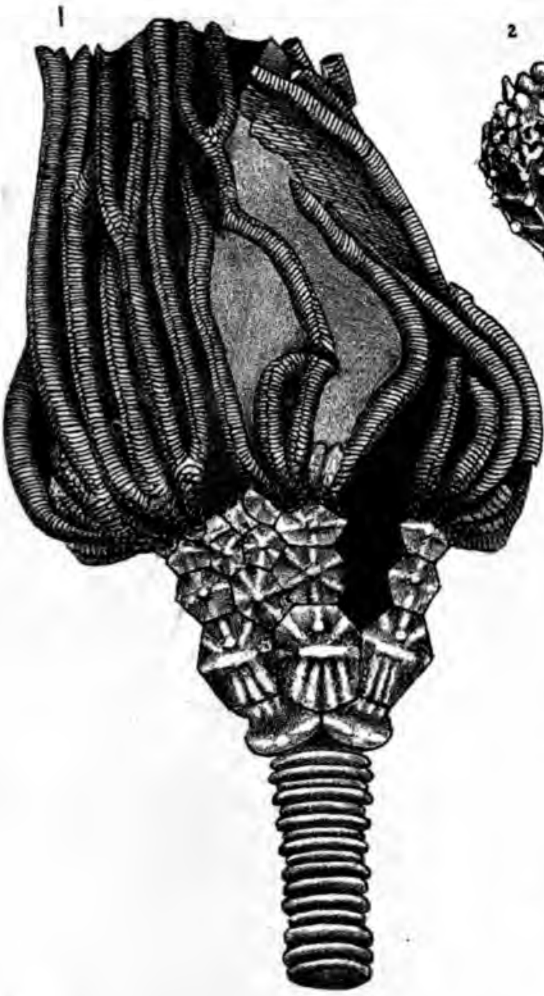

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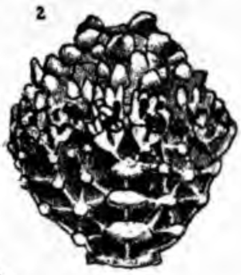

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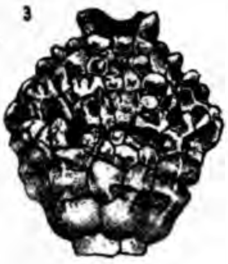

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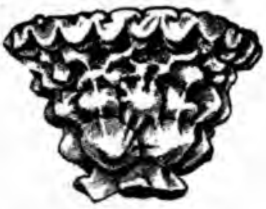

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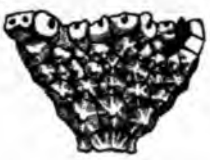

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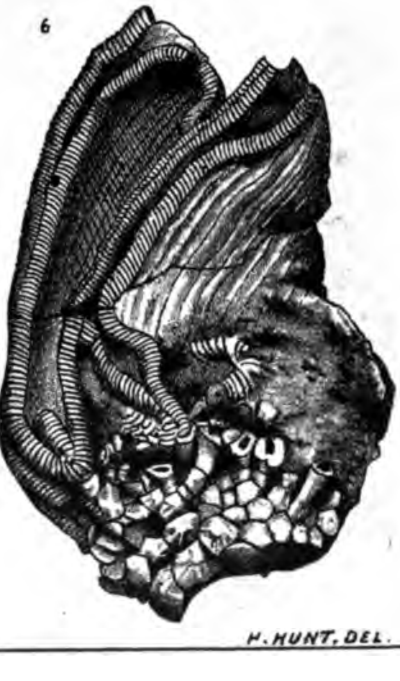

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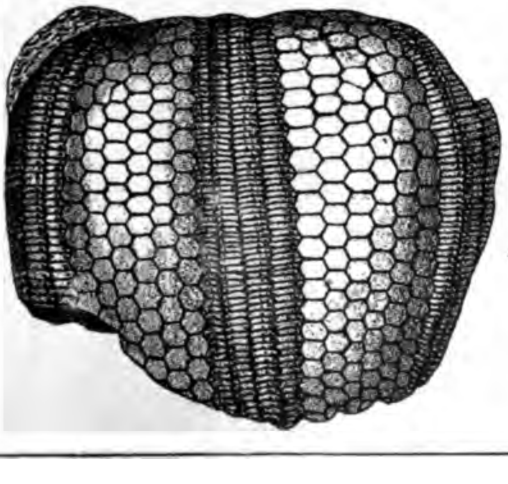

H. HUNT, DEL.

PLATE III.

PAGE.

Eretmocrinus lyonanus, n. sp. 17
Fig. 1. Basal view of a specimen showing arms expanded on the surface of a rock.

Cyathocrinus andersoni, n. sp. 30
Fig. 2. Symmetrical side.
Fig. 3. Azygous side.

Batocrinus lyonanus, n. sp. 18
Fig. 4. View opposite the azygous side.
Fig. 5. Basal view.

Barycrinus formosus, n. sp 33
Fig. 6. Azygous view of calyx, arms and column.

Cyathocrinus tumidulus, n. sp. 31
Fig. 7. View opposite the azygous side showing portion of arms.

Zeacrinus bellulus, n. sp. 34
Fig. 8. View of calyx and arms, azygous side on the left.

Talarocrinus trijugis, n. sp. 45
Fig. 9. Basal view.
Fig. 10. Summit view.
Fig. 11. View opposite the azygous side.

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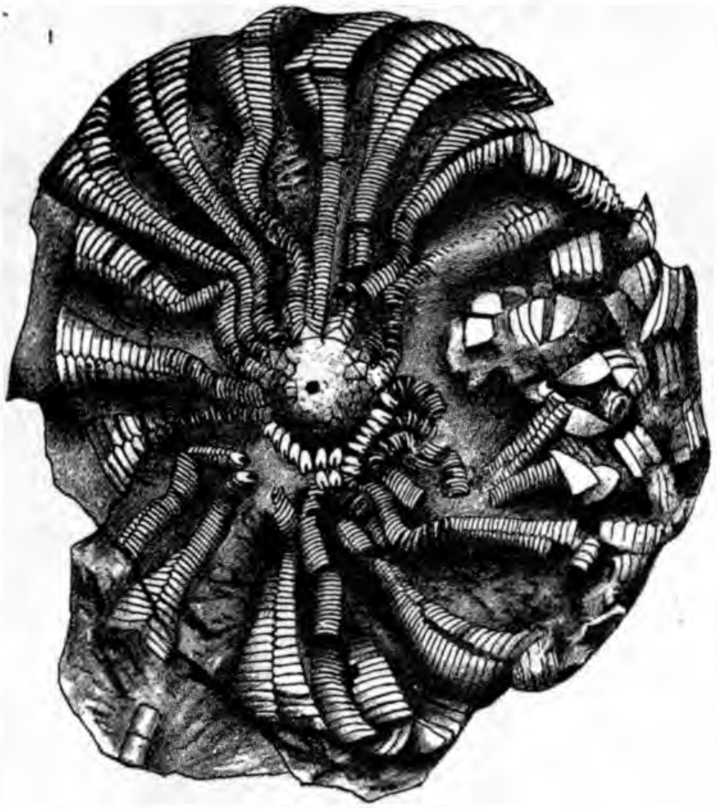

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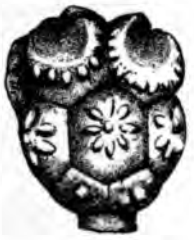

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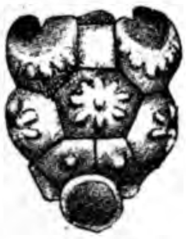

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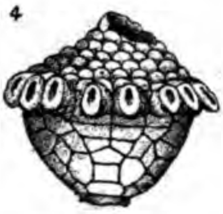

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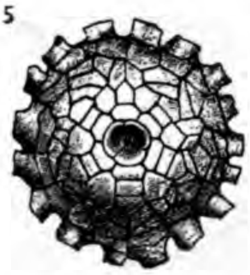

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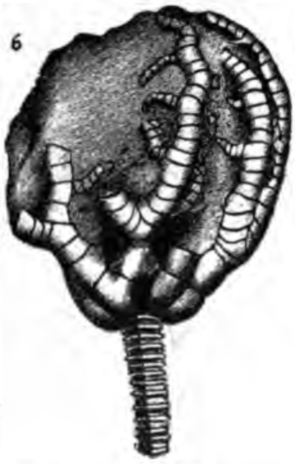

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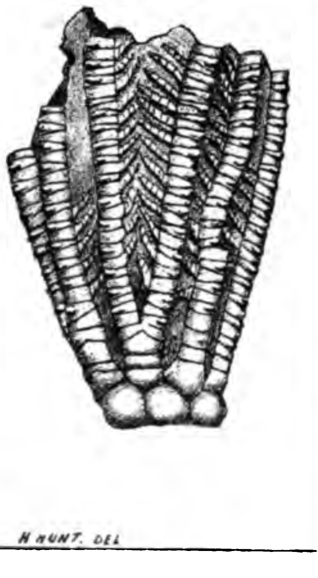

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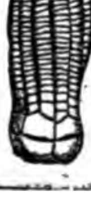

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PLATE IV.

PAGE.

FORBESOCRINUS PYRIFORMIS, n. sp. **47**
Fig. 1. View of an almost entire specimen.

EUCALYPTOCRINUS WORTHENI, n. sp. **53**
Fig. 2. Lateral view of calyx, arms and portion of the column.

TAXOCRINUS CRAWFORDSVILLENSIS, n. sp. **49**
Fig. 3. Lateral view of calyx, arms and portion of the column.

GONIASTEROIDOCRINUS LYONANUS, n. sp. **55**
Fig. 4. View of the vault and lateral prolongations.

ONYCHOCRINUS PARVUS, n. sp. **52**
Fig. 5. Azygous side view of calyx, arms and portion of column.

ZEACRINUS OBESUS, n. sp. **35**
Fig. 6. Side view showing the ray opposite the azygous area, on the right.
Fig. 7. Azygous view.
Fig. 8. Basal view.

SCAPHIOCRINUS MARTINENSIS, n. sp. **38**
Fig. 9. View showing calyx, part of the arms and part of the column.

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Bulletin No. 3. **Plate IV.**

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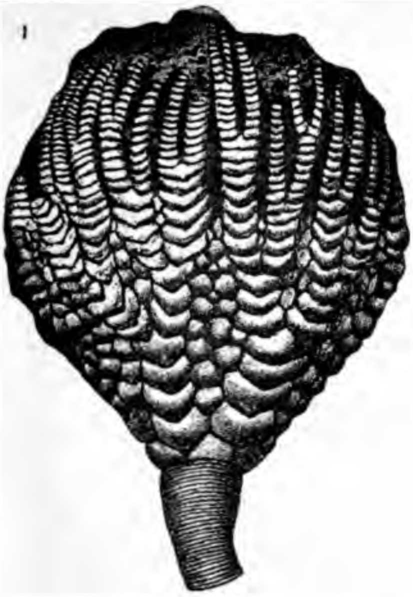

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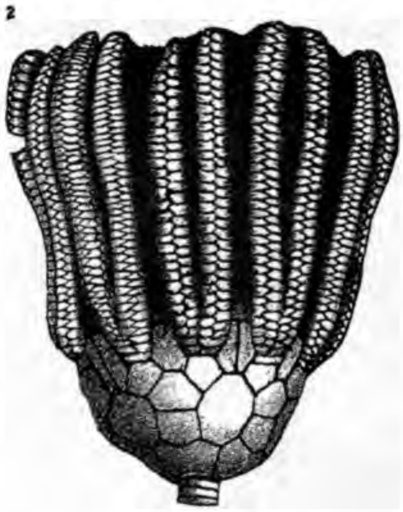

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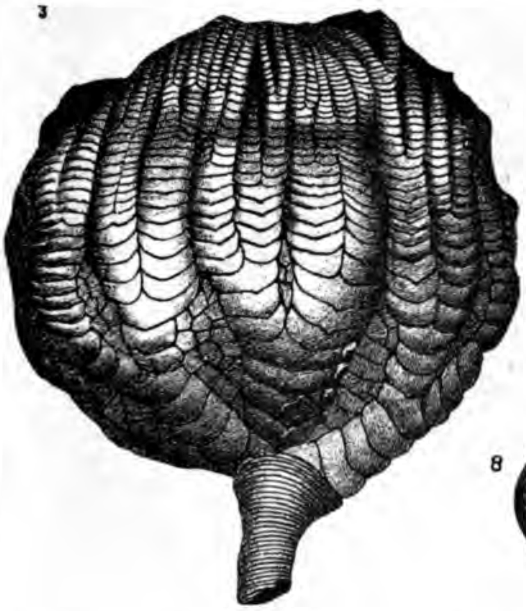

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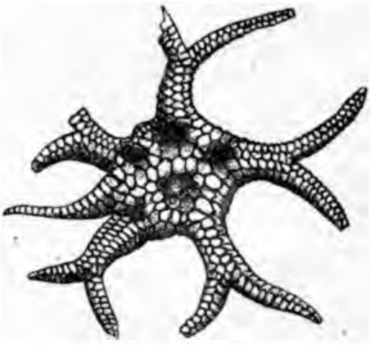

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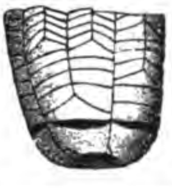

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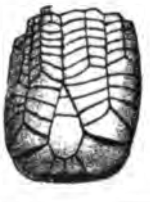

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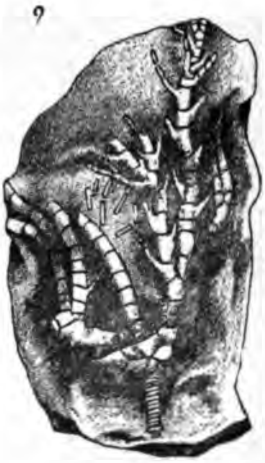

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PLATE V.

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BATOCRINUS ALTIUSCULUS, n. sp. 20

Fig. 1. Side view, azygous area on the right.
Fig. 2. Azygous view.
Fig. 3. Summit view of same specimen, part of the top being broken away.

BATOCRINUS ASPRATILIS, n. sp. 21

Fig. 4. Azygous view.
Fig. 5. Lateral view.
Fig. 6 Summit view.

BATOCRINUS SCYPHUS, n. sp. 23

Fig. 7. Azygous view.
Fig. 8. Lateral view.
Fig. 9. Summit view.

BATOCRINUS LAETUS, n. sp 24

Fig. 10. View opposite the azygous area.
Fig. 11. View of azygous side.
Fig. 12. View of summit of same specimen.

BATOCRINUS ÆQUABILIS, n. sp 25

Fig. 13. Azygous view.
Fig. 14. View of opposite side.
Fig. 15. Summit of same specimen.

ULOCRINUS BLAIRI, n. sp 57

Fig. 16. View of azygous side.
Fig. 17. Basal view.
Fig. 18. View opposite the azygous side.

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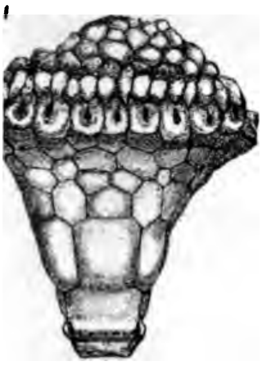

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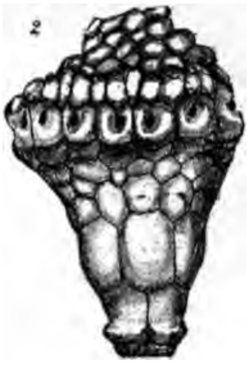

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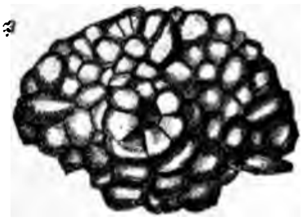

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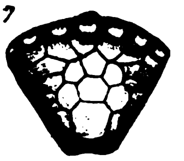

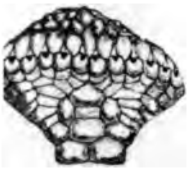

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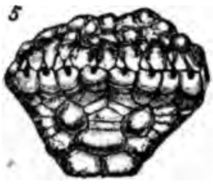

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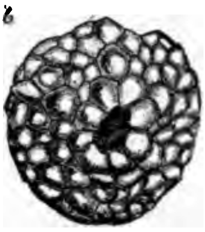

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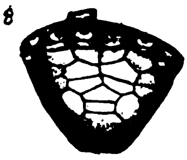

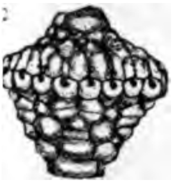

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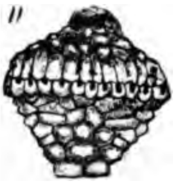

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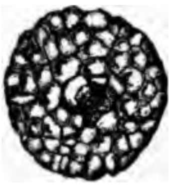

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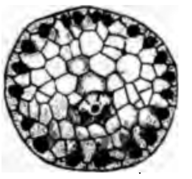

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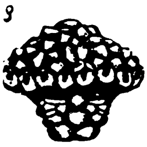

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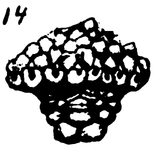

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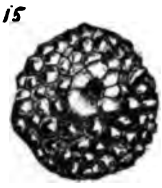

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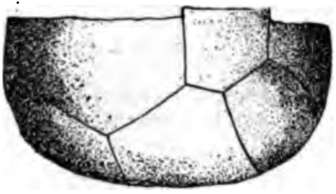

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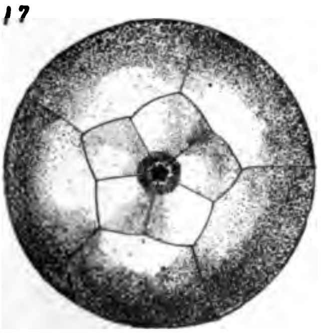

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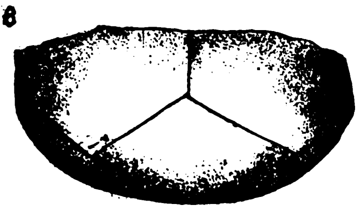

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Plate VI.

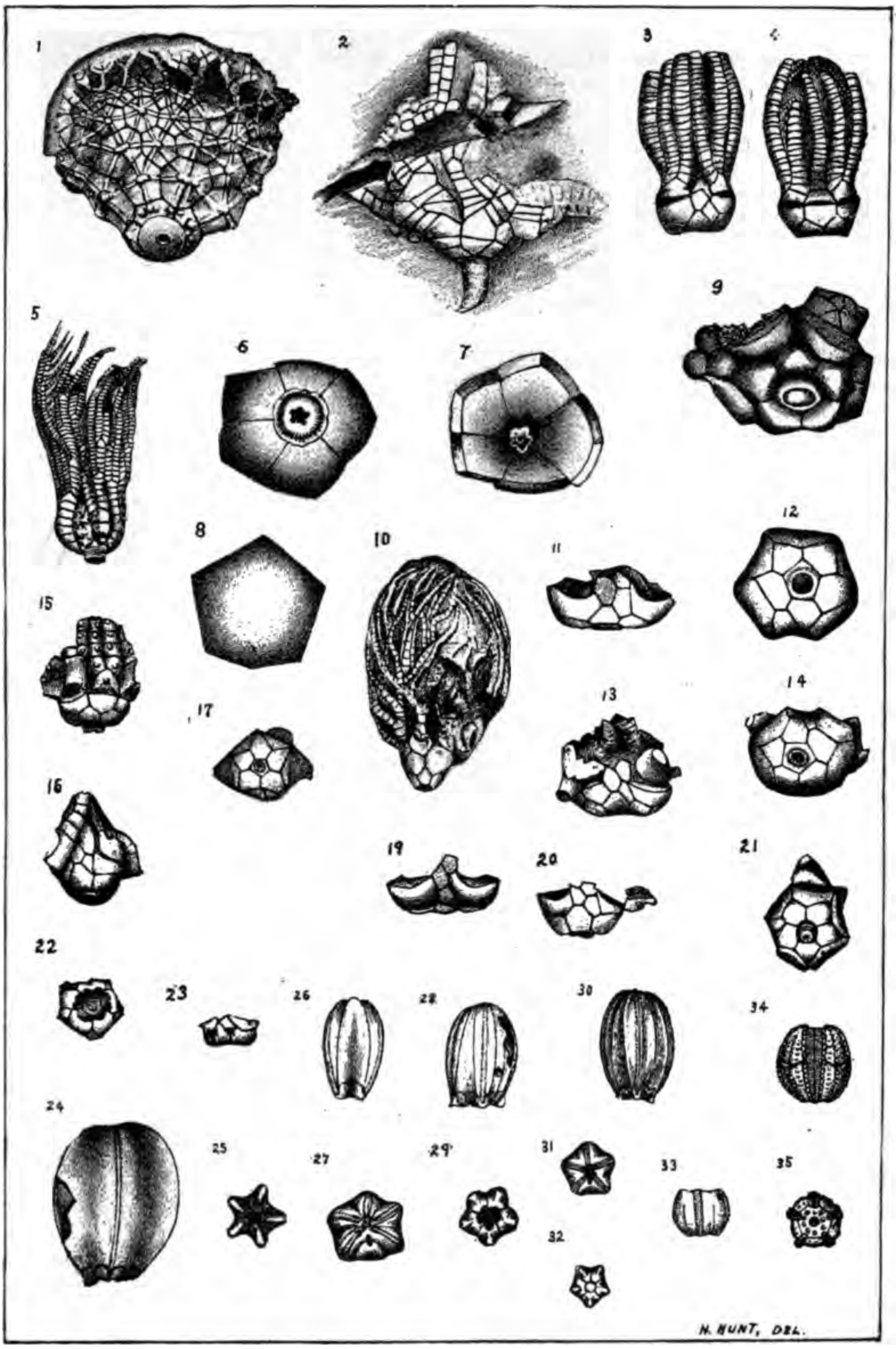
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PLATE VI.

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STROTOCRINUS VENUSTUS, n. sp 26

Fig. 1. Side and basal view of the calyx.

HYDREIONOCRINUS SANCTILUDOVICI, Worthen 40

Fig. 2. View of the type specimen.

ZEACRINUS NITIDUS, n. sp 36

Fig. 3. Azygous view.

Fig. 4. View opposite azygous side.

SCAPHIOCRINUS AEROSUS, n. sp 39

Fig. 5. View of azygous side of calyx and arms.

ULOCRINUS OCCIDENTALIS, n. sp 58

Fig. 6. View of the basal plates, part of two being broken away.

Fig. 7. Interior view of the same specimen.

Fig. 8. A subradial plate.

AESIOCRINUS ANGULATUS, n. sp 59

Fig. 9. View of calyx, part of an arm, and three azygous plates. The specimen is somewhat depressed.

CYATHOCRINUS SIGNATUS, n. sp 32

Fig. 10. Side view of calyx and part of the arms.

HYDREIONOCRINUS SUBSINUATUS, n. sp 40

Fig. 11. Azygous view of calyx.

Fig. 12. Basal view of the same specimen.

Fig. 13. Azygous side view of another specimen preserving part of the spinous second radials.

Fig. 14. Basal view of the same specimen.

HYDREIONOCRINUS NODULIFERUS, n. sp 41

Fig. 15. View opposite the azygous area.

Fig. 16. Azygous view.

Fig. 17. Basal view of the same specimen showing the protruding part of the second radials.

HYDREIONOCRINUS CRASSIDISCUS, n. sp 43

Fig. 18. Basal view.

Fig. 19. Azygous side of calyx.

HYDREIONOCRINUS GRANULIFERUS, n sp 44

Fig. 20. Azygous side view of calyx and one second radial.

Fig. 21. Basal view of the same specimen.

EUPACHYCRINUS PARVUS, n. sp 60

Fig. 22. Basal view.

Fig. 23. Azygous side view.

NUCLEOCRINUS GREENEI, n. sp 62

Fig. 24. Side view.

Fig. 25. Basal view.

NUCLEOCRINUS VENUSTUS, n. sp 63

Figs. 26, 28 and 30. Side views.

Fig. 27. Summit view.

Fig. 29. Basal view.

GRANATOCRINUS SPHÆROIDALIS, n. sp 65

Fig. 31. Summit view.

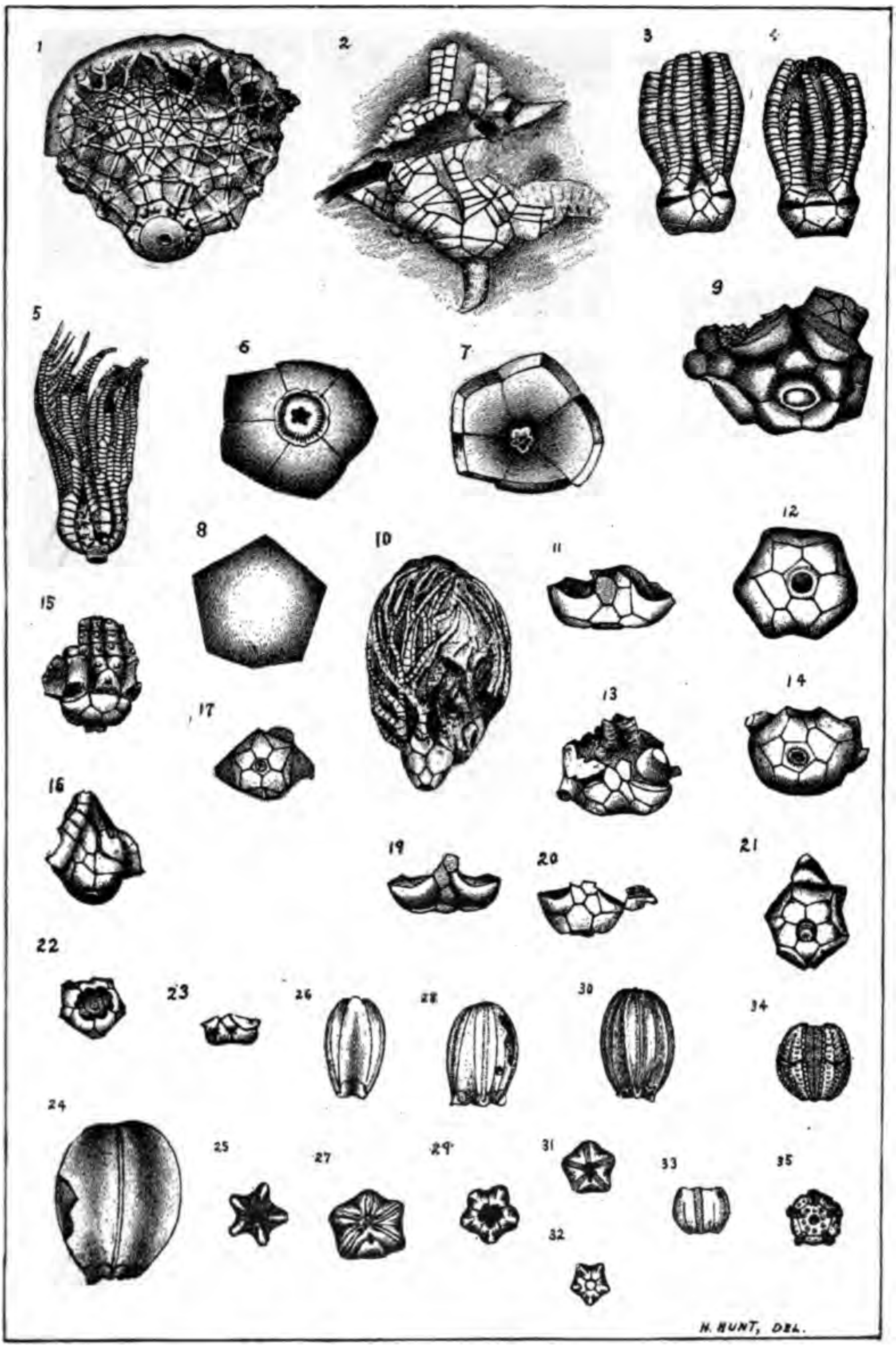
Fig. 32. Basal view.

Fig. 33. Lateral view—(The artist has overlooked the interradial sutures).

GRANATOCRINUS WINSLOWI, n. sp 66

Fig. 34. Side view.

Fig. 35. Basal view.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Bulletin No. 3. **Plate VII.**

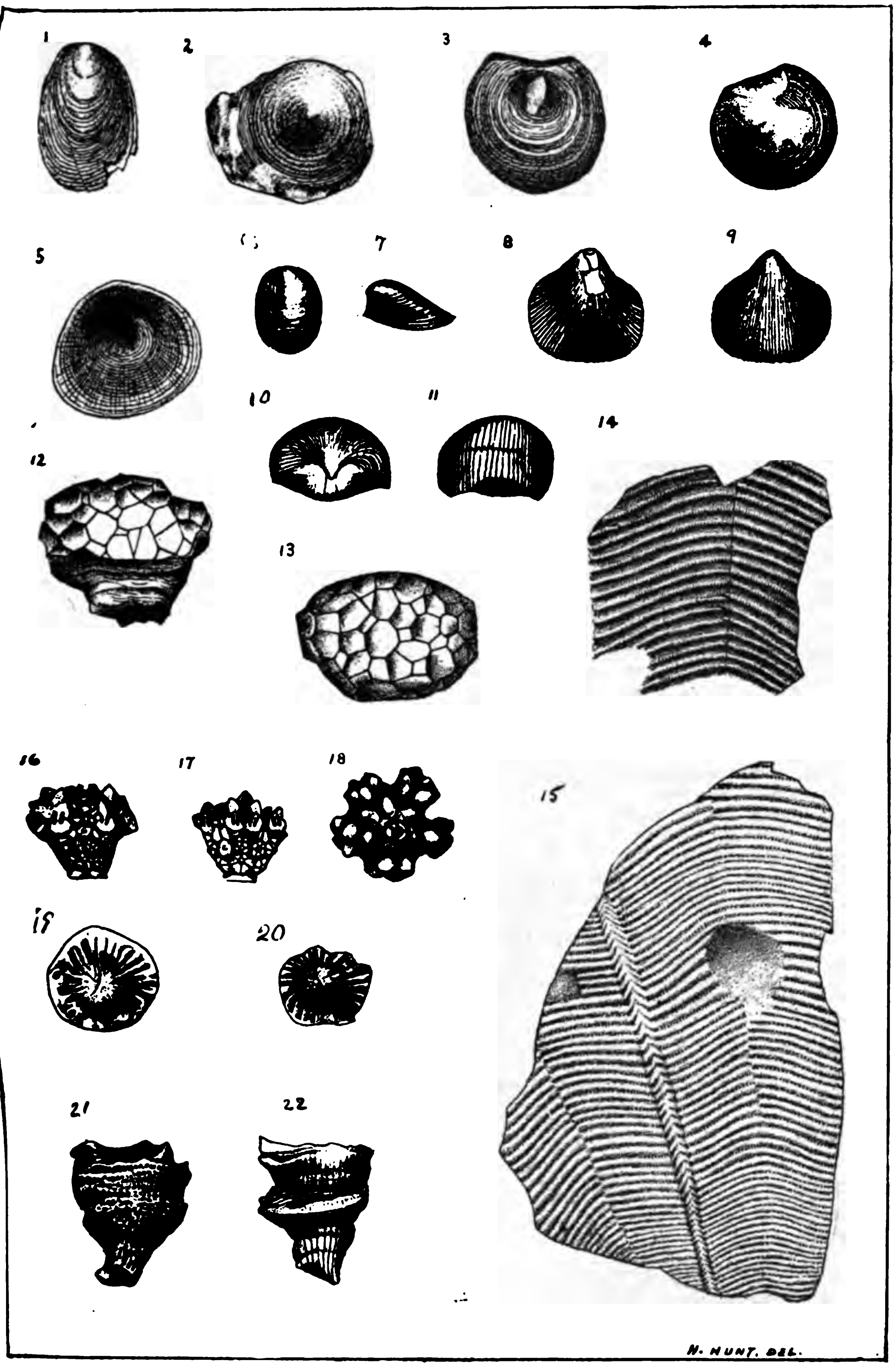

PLATE VII.

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Lingula indianensis, n. sp 69
Fig. 1. Ventral valve.

Discina illinoisensis, n. sp........................ 70
Fig. 2. Dorsal view.
Fig. 3. Interior of ventral valve.
Fig. 4. Dorsal valve of another specimen.
Fig. 5. Interior of a dorsal valve of another specimen.

Discina munda, n. sp........................ 71
Fig. 6. Dorsal view.
Fig. 7. Lateral view of the same valve.

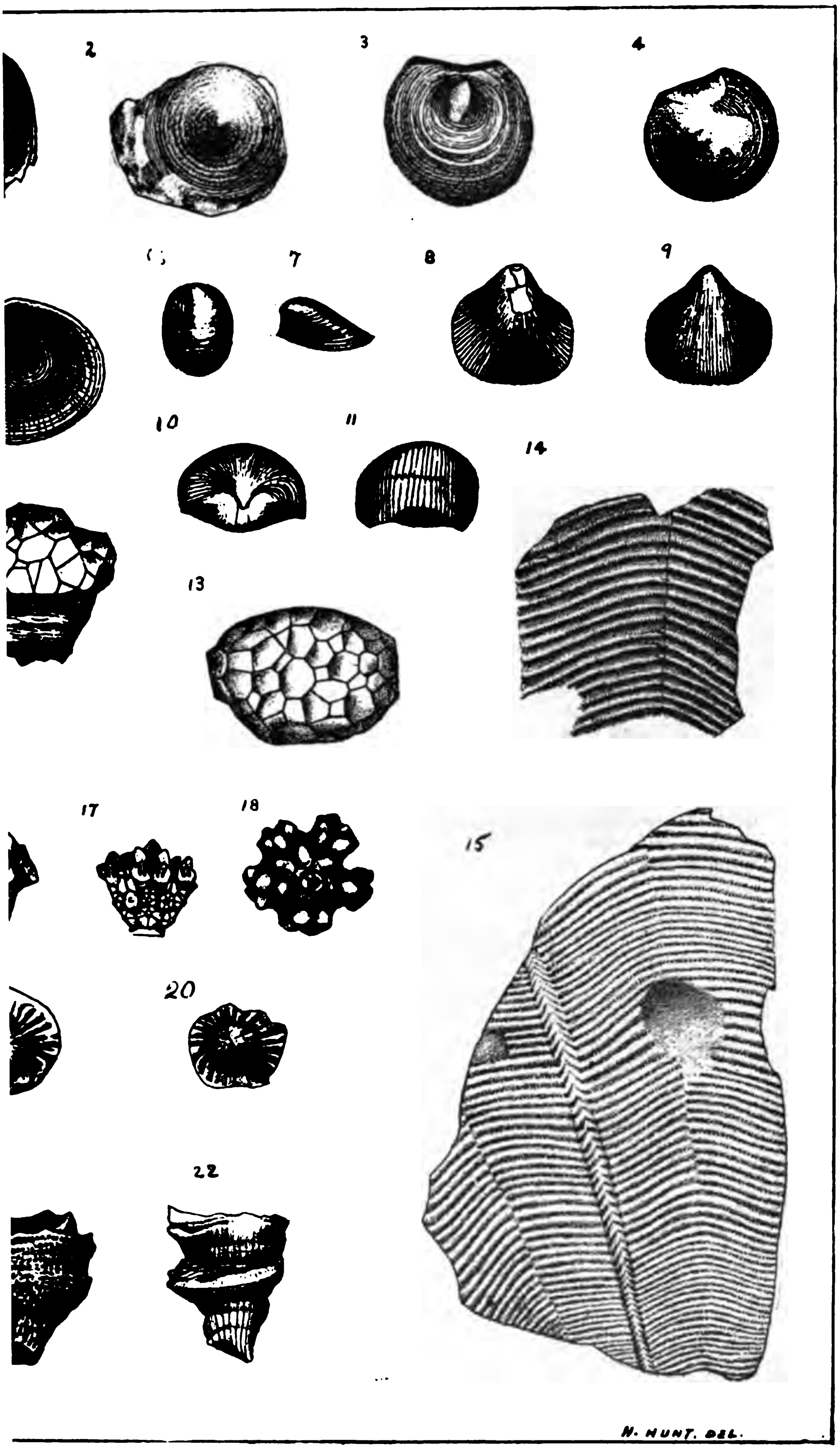
Eatonia coulteri, n. sp........................ 72
Fig. 8. Ventral view.
Fig. 9. Dorsal view.
Fig. 10. Cardinal view.
Fig. 11. Front view.

Michilinia branneri, n. sp 68
Fig. 12. Side view.
Fig. 13. Summit view.

Conularia blairi, n. sp 73
Fig. 14. Portion of surface of upper part of shell.
Fig. 15. A specimen showing a portion of the inside of a shell.

Blairocrinus spinosulus, n. sp........................ 28
Fig. 16. Azygous view.
Fig. 17. Opposite view of same specimen.
Fig. 18. Summit view.

Campophyllum kansasensis, n. sp........................ 67
Fig's. 19 and 20. Calyces.
Fig's. 21 and 22. Lateral views of same specimens.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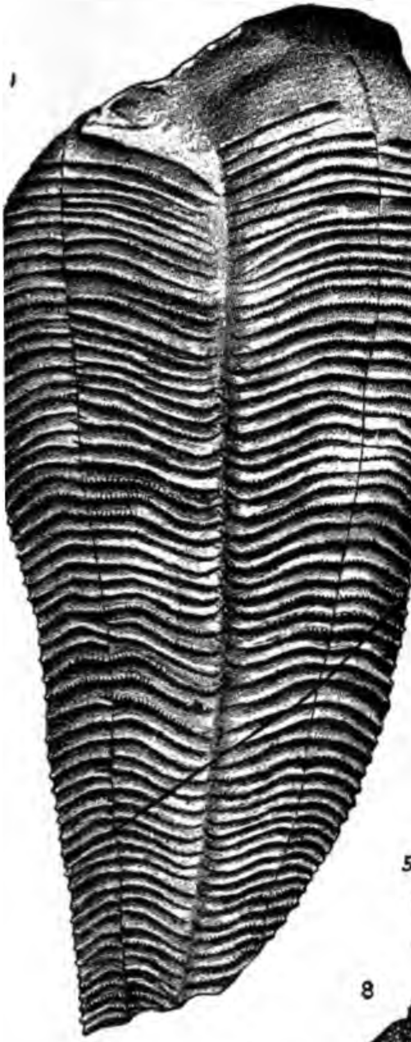

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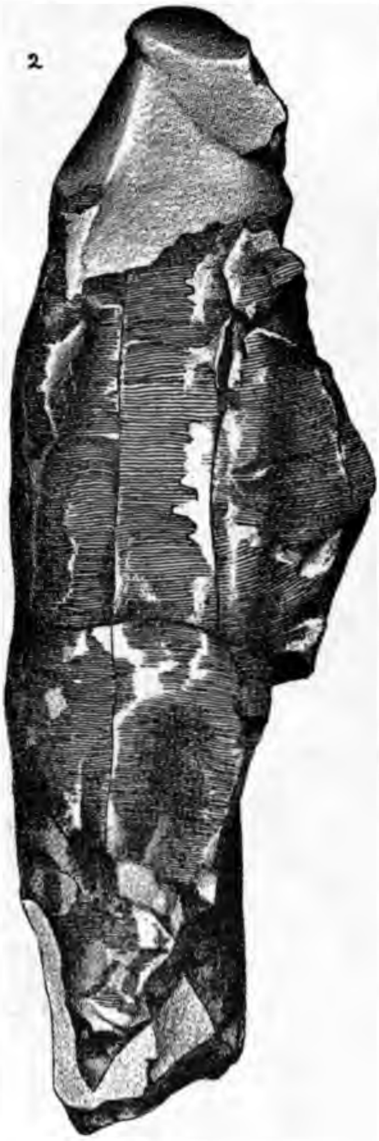

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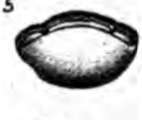

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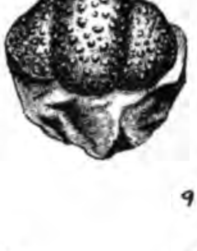

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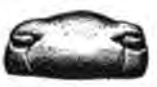

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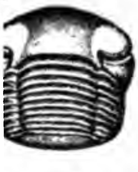

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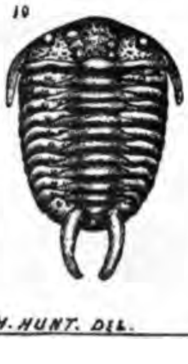

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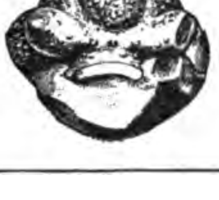

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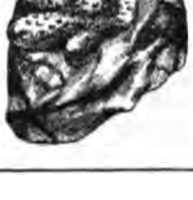

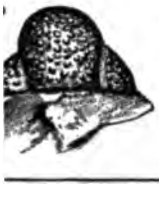

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BULLETIN NO. 4

OF THE

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OF

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UPPER DEVONIAN AND NIAGARA CRINOIDS.

By S. A. MILLER and Wm. F. E. GURLEY.

Springfield, Illinois,
October 15, 1894.

SPRINGFIELD, ILL.
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SUBKINGDOM ECHINODERMATA.

CLASS CRINOIDEA.

ORDER PALÆOCRINOIDEA.

FAMILY MELOCRINIDÆ.

DOLATOCRINUS MAGNIFICUS, n. sp.

Plate 1, Fig. 1, basal view of the calyx, injured in the middle part; Fig. 2, view of the vault, part of which is broken away and the sutures between the plates only partly preserved; Fig. 3, lateral view, with the six-armed ray in front and showing height of vault.

Calyx very large sub-hemispheroidal, broadly lobed in the radial fields and slightly concave below. The radial field opposite the azygous side is much larger, more prominent and more broadly lobed than either of the others. The diameter of the specimen illustrated is two and six-tenths inches and height one and two-tenths inches. The dome is only moderately convex, the radial areas being raised and the interradial areas depressed. Surface of the plates of the calyx sculptured, the larger ones bearing a central node. The radiating ridges do not connect from one plate to another, as is usual in the ornamentation of crinoids, but a radiating ridge may be directed toward the suture between two adjoining plates, instead of joining an end to that of a similar ridge on a contiguous plate; and there are shorter and longer ridges and nodes on the plates. The plates of a kind, however, are ornamented alike and on the whole the ornamentation is very pleasing.

The column, in our specimen, is broken off by an irregular fracture and part of the radial plates are injured. Enough is preserved, however, to show that the column is very large and conceals the basal plates that are deeply sunken in the interior of the calyx. The columnar canal is slightly pentalobate.

Basal plates concealed in the calyx. First primary radials probably as long as wide, including the projection up into the calyx to reach the basal plates, but one-half wider than high as exposed around the columnar cavity. The superior side of each is quite concave, and the inferior end is abruptly sunk in the basal cavity, so as to form a funnel around the upper end of the column, as we have seen in specimens of *D. marshi* and other species in this genus, but the depth of the funnel we have not observed in this species.

Second primary radials quadrangular, one-third wider than high, both the inferior and superior sides somewhat convex, and each bears a rather large central tubercle. The superior sides of these plates curve slightly upward and the inferior sides bend a little toward the basal depression, so that the calyx may be made to rest on the central tubercles of these plates.

Third primary radials, in four of the rays, pentagonal, larger than the second radials and about one-fourth wider than long. We will follow these four rays to the arms and afterward recur to the other ray. On each of the upper sloping sides of these four third primary radials there is a single, large, hexagonal, secondary radial, which supports on each of its superior sides two tertiary radials, the last of which supports the free arms. This gives us four arms to each of these four radial series.

In the other or fifth ray, which is opposite the azygous area, the third primary radial is broadly truncated above, hexagonal, twice as wide as high, and supports, upon its upper face, a series of three intersecondary and intertertiary plates, and upon each of its superior lateral sides a single large secondary radial, one of which is hexagonal and the other heptagonal. Each secondary radial bears upon its inner superior sloping side a series of three tertiary radials, the last one of which bears a free arm, and upon its outer superior sloping side a single, large, tertiary radial, which, in turn, supports upon each of its two upper sloping sides two radials of the fourth or quarternary series, the last of which support free arms. This structure gives to this ray six arms. The first intersecondary radial in this series is a large, quadrangular plate, having nearly equal sides; it is followed by an hexagonal plate abutting its two undersloping sides upon the secondary radials and two upper sloping sides upon the tertiary radials and supporting upon the upper truncated face a somewhat smaller pentagonal plate, that abuts its superior sloping sides against the adjacent tertiary radials, that support the free arms. The six plates that support the six free arms in this radial series abut against each other without any intervening plates.

There are, as shown above, twenty-two arms, in this species, which are more than have been found in any species heretofore described. If, however, the ray containing six arms and three interradial plates is abnormal the species would have twenty arms and still be so different from any species heretofore described that no comparison with any of them would serve any purpose in distinguishing it. There is nothing to indicate that this six-armed radial series may be abnormal and we believe it is in the normal condition of the species.

The first interradials are the larger plates of the calyx as exposed on the surface, and larger, in fact, than any of the other plates, unless the first primary radials, including that part which forms the funnel in the columnar cavity should prove to have as great or greater size. The one opposite the six-armed series or first azygous interradial is the larger one and has eleven sides; an approximate one is the smaller and has nine sides; the other three have ten sides each. The first interradial is followed by a single plate that extends nearly to the top of the calyx, and which, in turn, is followed by one or two small plates that separate the arms and connect with the plates of the vault, except in the azygous area, where three plates separate the arms and connect with the plates of the vault. The sutures between the plates in the upper part of some of the interradial areas are not distinct in our specimen, and for that reason are not shown in the illustration.

The dome or vault, as may be seen in the illustration, has part of the plates broken away on the azygous side and some of the sutures are anchylosed or obscure. It is, however, covered with large, polygonal plates of very unequal size. It is most convex toward the six-armed series opposite the azygous side and most sinuate or depressed at the azygous interradius. No pores or passages through the vault between the arms have been found in our specimen.

The specimen from which the foregoing description is drawn is the largest known Dolatocrinus. It was found in the Hamilton Group, at the Falls of the Ohio, and is now in the collection of Wm. F. E. Gurley.

DOLATOCRINUS SPINOSUS n. sp.

Plate I, Fig. 4, basal view of the calyx, without the surface markings of the plates; Fig. 5, lateral view, showing some of the spines on the plates of the vault.

Calyx large, subhemispheroidal, broadly lobed in the radial fields, and depressed concave on the lower side. Apparently no azygous interradius. The diameter of the specimen illustrated is two and two-tenths inches, and height three-fourths of an inch, though we have seen specimens only about two-thirds as large. Vault moderately convex and slightly depressed in the interradial areas. A strong ridge crosses the primary radials. Column round and deeply inserted in the calyx. Surface ornamentation not preserved in any of our specimens.

Basal plates sunk deep within the calyx and extending internally as high as the arm openings. First primary radials twice as wide as high externally, but near the middle of the plates they are abruptly bent, almost at right angles, into the basal cavity, where they form a funnel to the basal plates, into which the column is inserted, so that, in fact, their length is fully equal to their greatest width. The superior face is slightly concave.

Second primary radials quadrangular and more than one-half wider than high. Third primary radials slightly larger than the second, pentagonal, a little wider than high, and supporting upon each upper sloping side a single secondary radial.

Secondary radials nearly as large as the third primary radials pentagonal, and supporting upon each upper sloping side a series of three tertiary radials, the last one of which bears the free arms. The first tertiary radials are larger than the second or third. The species bears twenty arms.

The first interradials, in each area, are elongated eleven sided plates and larger than any of the other plates in the body. Each one is followed by an hexagonal plate that is as long or longer than wide and supports three narrow, elongated plates in the third range that reach as high as the base of the arms. These are followed, in the fourth range, by three plates that separate the arms, and unite with the plates of the vault. One or two intersecondary plates (apparently a pair of them) are inserted at the base of the arms in the intersecondary areas, but it is not clear, in our specimens, that they unite with the plates of the vault. Probably they do not, but as the sutures are destroyed this cannot be determined.

The limestone matrix covers the greater part of the vault, in our best specimen, so that but little can be said of it beyond what is shown by the illustration. It is characterized, however, by a plate over each double radial series which bears a very long, strong spine. The broken ends of spines belonging to other plates are preserved in the matrix, but there is no evidence of a proboscis. The summit of the vault is apparently below the top of the matrix shown in the illustration, and not as high as the top of the spines over the radial series.

There have been described, heretofore, only two species bearing twenty arms—*D. lamellosus* and *D. troosti*—and this species is so far removed from them that comparison is unnecessary.

Found in the Hamilton Group, at Charleston, Indiana, and now in the collection of Wm. F. E. Gurley.

DOLATOCRINUS LACUS, Lyon.

Plate I, Fig. 6, side view; Fig. 7, basal view.

Lyon described the body as "subglobose, truncated below, columnar pit broad and deep; summit somewhat conical, prolonged by a proboscis: column round, columnar perforation rather large and pentalobate." He said; "The body is adorned by a most beautiful network of raised triangular figures; the points of the principal triangular figures rise from, and terminate at the center of the first interradial pieces; a subordinate set of figures terminate at the center of all the pieces below the arms. In some specimens the lines are continuous, in others, interrupted. The summit pieces are sometimes adorned by a single prominent granule; in other specimens, many of the pieces are ornamented by a number of granules, arranged in lines across some of the pieces in nearly parallel rows, or in a circular band around a more prominent central one."

Our specimens agree with the above description and in comparison with other species we would note the high calyx, with a slight constriction below the arm bases, the flattened or truncated base, and pentagonal, funnel shaped, columnar pit, bounded externally by a raised ridge running from a central tubercle on each first radial to another, so as to bound the columnar cavity with a raised pentagonal figure. We have illustrated a basal view to show this pentagonal outline, because Lyon's figure does not show its pentagonal character.

The basal plates are deeply sunken. First primary radials including the extension into the columnar cavity longer than wide; ornamented with sculptured ridges, which terminate at a central node, at each angle of the columnar depression. Second radials quandrangular, wider than high, and bearing a central node. Third radials pentagonal, wider than high, and bearing a central node. First secondary radials as large or larger than the third primary radials. Second secondary radials much smaller and of irregular form and size. Third secondary radials still smaller and of irregular form and size. Arms, ten, composed of ovoid flat pieces of equal thickness.

First interradials the larger plates of the calyx, nine-sided, subovate, angularly pointed below and resting between the upper sloping sides of the first primary radials, the upper sloping sides separate the first secondary radials and the superior side is truncated for a single plate in the second range. Second interradials subquadrate, four pentagonal and one quandrangular and followed by two small plates in the third range (in some areas there are three) and these by three smaller, elongated plates (sometimes there are only two) that separate the arms and unite with the plates of the vault. Intersecondary plates, two, similar to the last three in the interradial areas, and separating the arm bases and uniting with the plates of the vault. Above the summit of the three intersecondary plates and also above the summit of the last two or three interradials, two elongated pores or passages penetrate the vault horizontally. In some interradial areas there are four of these pores, especially where there are three plates in the third range. These pores are conspicuous, in our specimens, but they seem to have been entirely overlooked by Lyon, for they are not shown in his illustration or mentioned in his text. We have given a side view of a specimen for the purpose of showing the interradials and intersecondary plates and the pores, because Lyon's illustration is very erroneous and defective, in all these respects.

Found in the Upper Helderberg Group, at the Falls of the Ohio, and in Clark County, Indiana.

DOLATOCRINUS MARSHI, Lyon.

Plate 1, Fig. 8, showing the abrupt bending of the first radials into a pentagonal funnel shaped cavity.

This species was described and illustrated, by Lyon, in 1869, in the Transactions of the American Philosophical Society, vol. XIII, p. 461, pl. XXVII, Figs. *n, n1 and n2.* His description and illustrations are very good, and for the purpose of identifying the species none other are necessary, but that publication is rare and but few western people ever have an opportunity to see it, and, for that reason alone, we are justified in redescribing it. But our principal object, in calling attention to it, is for the purpose of redescribing and showing a basal view, as we have a specimen hollow on the inside and showing both the exterior and interior of all the plates.

Lyon described the calyx as "discoid, with five broad, sharp carina, which rise perpendicularly from the margin of the basal pit, and extend outward, equally elevated to the center of the third radials, the carina rising gradually from the margins of the radials, then more rapidly to the center of the pieces. At the center of the third radials the carina sends out branches, not quite so bold as the main stem, but strong, involving all the pieces of the superradials up to the arm bases. Arm bases prominent, in groups of two to each ray, producing a lobed, pentagonal figure of that section of the body. The dome is subconical; twice as high as the body below the arms; surmounted by a thick, strong, subcentral proboscis. The interradial fields unite to the dome-covering between the arms."

The characters above described, to which special attention may be directed, are the low calyx, high vault, subcentral proboscis and carina. Instead of ordinary radial ridges occupying the central part of the radial plates, the whole plates are involved in forming a high central ridge, in each series, which Lyon calls the "carina." And they "rise perpendicularly from the margin of the basal point," which is a striking peculiarity, much more noticeable in a specimen than it is in his illustration or in ours, though the attention of the artist was called specially to it, and our figure is accurate except in giving a full idea of the height of the "carina" at the "basal pit." The surface of the plates is covered with fine ridges, disposed in groups, radiating from the center of the plates.

The basal plates form a cone, the top of which is on a level with the top of the calyx. The internal position which they occupied, probably caused them to become anchylosed, at all events, one cannot see any possible flexibility they could give the animal, in that situation, if they were not anchylosed. The summit of these anchylosed plates is perforated with a large pentalobate or cinque-foil columnar canal. There is a rim, formed by a thickening of the plates, within the apical part of the cone to which the end of the column was attached, and it appears that the column filled the interior of the cone and the plates were more or less attached to it.

The first primary radials form a pentagonal funnel that extends to the base of the cone formed by the basal plates. The length of the funnel, without including the height of the carina, is equal to the greatest width of the radials. In other words, the length of the first radials is more than their greatest width, but the plates are abruptly bent, and four-fifths of the length is within the funnel-shaped basal cavity, and only one-fifth without, which is very little more than the thickness of a plate. It seems quite impossible to show the true depth of the funnel, by pen drawing, but the artist has indicated it as well as he could, in the illustration, which is a character not attempted to be shown, in Lyon's figure of the base of the calyx of this species. In the inside of the calyx, neither the pentagonal form of the funnel nor the external carina are indicated, but a round cone is formed by the extension into the interior of the first radials and basal plates.

Second primary radials quadrangular one-half wider than long. Third primary radials wider than the second and wider than long, pentagonal, and support on each upper sloping side three or four secondary radials, the last of which supports the free arms. The radial series are of variable length within the calyx, as mentioned by Lyon, which somewhat destroys the symmetry of the calyx. There are ten arms.

There are from seven to nine interradials in each area. The first is large, subovoid and has nine sides, it supports a hexagonal plate as large as a primary radial, and it is followed by three plates, in the third range, except in one area, where there are only two. There are two plates in the fourth range, except in one area, where there are four, and two in the fifth range, to which are united the points of the long pieces that lie between the lobes on the dome, according to Lyon. Some specimens, however, we think show more than two plates, in the last range, in some of the areas.

There are from two to four intersecondary plates in each area wedged between the arm bases; when four, they are in pairs, one above the other.

"The dome is covered by large pieces; each field between the lobes contains a pair of the largest, which reach from the arm-bases toward the proboscis; they are six or seven sided; long; broadest at the upper extremity; pointed, or very slightly truncated at the lower end; joining each other by their longest sides, at the center of the depression between the lobes. A circle of large pieces surround the dome; all of these rest partly upon the ten long pieces. The pieces composing this zone are of different sizes; they also differ in form; all six sided; two of the largest pieces of the circle rest directly over two of the long pieces; three other groups of the long pieces unite under the suture, uniting two of the pieces forming the circle, so that the sutures, uniting both sets of pieces, form one line from the arm bases to the base of the second circle surrounding the dome near the base of the proboscis. Below the zone described, and between the groups of long pieces, are groups of from five to seven pieces, the upper one of which is joined to the circle above the group of long pieces, and on which it rests. The lowest piece of these groups is lanceolate; is lodged between the arm bases, and unites with the interbrachials. The upper and largest piece of these several groups is of the same size and form as the pieces comprising the first zone around the top of the dome. Around the arm bases the pieces are numerous and quite small. The pieces comprising the lower zone, and the large ones of the groups above the arms, are surmounted by a group of from three to five rough, pointed spines, confluent near their bases. The plates of the second zone at the base of the proboscis are ornamented with hemispherical tubercles, all other pieces of the dome are gibbous or concave and not ornamented."

In this species there are from four to six pores between each of the arm bases, that were not mentioned by Lyon, or shown in his illustrations, and which are quite conspicuous in our specimens. These pores or passages are elongated. They commence by a slight horizontal furrow across the top of the last interradial plates in the calyx and penetrate the adjoining plates of the vault horizontally, which makes an elongated surface opening. This feature is present and even more noticeable in *Dolatocrinus grandis* and may be understood by referring to the illustration of that species. We know all these openings penetrate the test because we can see through them.

This species occurs in the Upper Helderburg Group, at the Falls of the Ohio, and in Clark county, Indiana.

DOLATOCRINUS GRANDIS, n. sp.

Plate II, Fig. 1, basal view of the calyx; Fig. 2, view of the vault broken in the central part; Fig. 3, lateral view.

Calyx very large, subhemispheroidal, quite concave below, the concavity including part of the third primary plates, and most depressed in the interradial areas. The diameter of the specimen illustrated is two and three-tenths inches; height to the place where the vault is broken, one and fifty-five hundredths inches; height of calyx, nine-tenths of an inch; height of vault, if unbroken, and calyx about equal. The vault is quite convex, a little more abrupt on one side than the other, indicating that it possessed a proboscis on the abrupt side, and it is very slightly depressed in the interradial areas. Surface of the calyx beautifully and delicately sculptured, numerous raised lines seem to cross the sutures from one plate to another, but none of them arise from nodes or tubercles. The sutures are not beveled and in some parts they are very indistinct. The sutures on the vault are distinct and beveled and between the larger plates they are broadly and deeply grooved, the grooves being bounded with a rim of granules, while the central part of each plate is concave or sculptured and sometimes granulous. The columnar cavity and part of the first primary radials, in our specimen, are covered with the limestone matrix.

First primary radials very little wider than high, upper side transverse. Second primary radials quadrangular and about one-fourth wider than high. Third primary radials larger than the second, pentagonal, and from one-fourth to one-third wider than high. The superior sides bend upward and the inferior sides curve into the basal depression so that the calyx can be made to rest on a smooth surface on the third radials. Each one supports on each upper sloping side a series of secondary radials the last ones of which support the free arms.

The first secondary radials are fully as large or larger than the third primary radials, rather wider than high, part of them pentagonal and the others hexagonal, and each one abuts upon the first interradial and one of the plates in the second range of interradials. The second secondary radials are as large as the first and wider than high, but not of uniform size. The third secondary radials seem to be smaller than the second, but the sutures are anchylosed, or so obscure, in our specimen, that the outlines cannot be accurately determined. Above these the arm bases become prominent. There are only ten arms in this species, but they are very large and composed of a double series of interlocking plates.

The interradial areas are not exactly of uniform size nor is it certain that they are filled with the same number of plates. The first interradials are the larger plates in the calyx. Each one has ten sides, is much elongated, rests its lower angle between the two upper sloping sides of two first primary radials, and separates the first secondary radials between its upper lateral sides, and supports upon the two superior faces two rather large and more or less elongated plates in the second range. In some areas these plates are larger than in other areas. In three of the areas, where the sutures are distinct, there are two plates, in the third range, about half the size of those in the second range, four small plates in the fourth range, six still smaller plates in the fifth range, and eight small plates in the sixth range, that form the top of the calyx between the arm bases and unite with the plates of the vault, in a zig zag line. Whether or not the plates in the other two areas are the same cannot be determined from our specimen.

The intersecondary areas are short, but almost like the interradial areas, in the upper part, and the plates consist of four ranges. The first one, consisting of two plates, rests between the upper slightly sloping sides of the second secondary radials and in line with the third range of interradials; it is followed by four plates in the second range, six in the third range and eight in the fourth range, that unite with the plates of the vault, in a zig zag line. The sutures are so obscure between the small plates, in some of the areas, that it cannot be determined whether or not all the areas are exactly alike. The arms are separated about equally distant from each other, whether by the interradials or intersecondary radials.

There seems to be no azygous area in the calyx.

The vault, in our specimen, as may be seen in the illustration, is broken away at the summit. It is, however, highly convex, the convexity probably equalling the height of the calyx, and covered with ornamented polygonal plates arranged in peculiar and systematic order. The sutures are distinct, even between the smaller plates, and the edges of the plates are beveled, and between the larger plates the sutures are widely grooved. The plates are depressed convex, concave in the center and more or less sculptured and granulous. The smaller plates are over the arm furrows and regularly interlock. The plates toward the central area are large and polygonal. The plates in the interradial areas are elongated and arranged fan like, in some of the areas, and more like a keystone arch in others, which have a very long, wedge shaped plate in the middle. There are eight or ten plates in each depressed interradial area. A horizontal furrow crosses the top of each of the last plates of the calyx and penetrates the vault at the suture between the plates of the interradial areas. There are, therefore, eight or ten horizontal elongated pores or passages that penetrate the vault between each of the arms. They are shown in the illustration. This subject will be further considered in remarks at the close of the descriptions of *Dolatocrinus* in this article.

Found in the Hamilton Group, at Louisville, Ky., and now in the collection of Wm. F. E. Gurley.

DOLATOCRINUS ORNATUS *var.* ASPERATUS, n. *var.*

Plate II, Fig. 4, basal view, Fig. 5, view of the vault; Fig. 6, side view.

Calyx low, basin shaped, flattened or truncated at the base as far as the extent of the second radials; columnar cavity small; primary radial ridges prominent; surface of all the plates closely and radiately sculptured and pitted.

Basal plates hidden by the column, which is round and pierced with a cinque-foil canal. First primary radials longer than wide and only a small part at the lower end is curved into the columnar cavity. Strong radial ridges rise on the first radials, cross the second and terminate at a tubercle on the third radials, from which a delicate ridge crosses each secondary radial. The radial ridges are most prominent in the central part of the plates. The radiating lines from the commencement of the radiating ridges form a pentagonal figure around the small columnar cavity. Second primary radials quadrangular and wider than long. Third primary radials larger than the second, wider than high, pentagonal and support on each upper sloping side two secondary radials.

First secondary radials about as large as the third primary radials and hexagonal, except in some instances, where slightly truncated by a small plate resting between the upper lateral side of the second interradial and the base of the arm, they become heptagonal. Second secondary radials much smaller; they separate the arms and extend to the summit of the calyx and slope laterally. There are ten arms, composed, at their origin, of a double series of plates. No intersecondary radials.

The first interradials are the larger plates of the body and have nine sides. The second interradials are less than half as large as the first and hexagonal; the three superior sides are the shorter ones; the upper truncated side extends to the summit of the calyx and a small vault plate abuts laterally against it. A small plate rests between each superior lateral side and the second secondary radial and forms part of the support of the free arm. There is no azygous area.

The vault is only slightly convex and very much depressed in the interradial areas, especially between the arm bases. It bears a small subcentral proboscis that is not preserved in our specimens. It is covered with rather large, polygonal, tuberculated plates, two of which, in each depressed interradial space, are elongated, and the larger plates of the vault. There are no pores or passages that penetrate the vault between the arms.

Found in the Hamilton Group, near Charleston, Indiana, and now in the collection of Wm. F. E. Gurley.

DOLATOCRINUS ORNATUS, Meek.

Plate II, Fig. 7, basal view; Fig. 8, summit view; Fig. 9, side view of the same specimen from Columbus, Ohio.

The following is the definition of this species, by Meek, from the Proceedings of the Academy of Natural Sciences of Philadelphia, 1871. p. 57. It has never, before, been illustrated.

"Body including the vault, depressed subglobose, the portion below the arm bases being a little higher than the vault, with nearly vertical sides above, but rounding under below to the somewhat flattened under side; arm bases protuberant, mainly in consequence of the rather deep furrows or sinuses of the vault over the interradial areas; vault composed of irregular pieces, each of which projects in the form of a little sharply prominent node or short spine, the largest of which are situated around the nearly central ventral tube, and on the elevations between it and the arm bases. Base small, a little compressed within the shallow concavity of the under side, and marked by a distinctly indented column-facet, which occupies near three-fourths of its entire breadth, so that only a narrow ring, as it were, of the basal pieces can be seen when the column is attached. First radial pieces comparatively large, extending out nearly horizontally, or only a little arching upward, and with their inner ends curving slightly into the shallow central concavity; all wider than long, and hexagonal, with the upper (outer) side of each longer than any of the others. Second radial pieces about half as large as the first, wider than long, and quadrangular in outline. (In one ray of the typical specimen the second radial is abnormally wanting, while the third is larger than usual.) Third radials about as large as the second› from the curved-up edges of which they rise vertically wider than long, and pentagonal in form; bearing on each of their superior sloping sides a smaller secondary radial, each of which supports another smaller, more or less cuneiform piece, from which the arms arise; thus making two arms from each ray, unless the number is increased by bifurcations after they become free; arms unknown, but apparently composed, at their origin, of a double series of alternating pieces.

"First interradial pieces, somewhat larger than the first radials, about as wide above the middle as their length, eight or nine sided, with the lower part of each curving under to connect with the first radials, while they curve upward vertically from near or below the middle; each supporting on the upper side a much smaller hexagonal piece, which rises vertically, and usually bears on its short superior lateral edges two smaller pieces connecting with the secondary radials or first arm-pieces, while its short truncated upper side is not surmounted by any succeeding piece, but connects on its inner surface with the vault.

"Sutures between all the plates channeled. Surface of body plates ornamented with raised lines or very small radiating costæ, that cross the sutures parallel to each other at the sides of the plates, but soon become bent about and connected, in various ways, so that very few of them extend directly to the middle of any of the plates, the arrangement being such as to produce a kind of vermicular style of ornamentation, especially over all the central part of the plates, like that often seen on the body plates in *Amphoracrinus*. A small rather sharp ridge also extends up the middle of each radial series of plates, more or less interrupted at the sutures, and showing a slight tendency to form a pinched node on the middle of the first and second radials; while it is sometimes seen to bifurcate on the third radial, to send branches to the secondary radials, but these are generally so small as scarcely to be distinguished from the other little ridges ornamenting all of the body pieces.

"Ventral tube unknown, but judging from the spiniferous character of the vault-pieces around its base, probably also spiniferous.

"Height of body to arm-bases, 0.47 inch. do. to top of vault, 0.60 inch; breadth, 0.95 inch."

The specimen illustrated is from the typical locality, in the Upper Helderburg Group, at Columbus, Ohio, and is from the collection of Charles Faber. It will be observed that it is about the size of the type described by Meek, and agrees with it in all particulars. The variety *asperatus*, above described, has a proportionally longer calyx, which produces some difference in the relative sizes of the plates, but this alone would not be of varietal importance; taken, however, in connection with the different surface ornamentation and the great difference in the ridges that cross the radial plates, varictal characters may exist. The plates on the superior lateral sides of the second interradials are proportionally smaller in *D. ornatus* than in *D. ornatus var. asperatus* and other minor differences might be pointed out, but they do not seem to us to constitute specific differences, though the two forms on cursory examination are readily separated. If the arms were preserved possibly the two forms could be specifically distinguished.

DOLATOCRINUS STELLIFER n. sp.

Plate II, Fig. 10, basal view; Fig. 11, view of the vault, only part of the sutures can be distinguished and the ornamentation is not preserved; Fig. 12, internal view of the calyx showing the basal plates and part of the first primary radials.

Calyx low, basin shaped, three time as wide as high, deeply and broadly concave below, the concavity extending to the middle of the first interradials; columnar cavity deep; radial ridges quite small. Surface of all the plates deeply, closely and radiately sculptured.

Basal plates extending in a cylindrical form up as high as the top of the calyx and completely hidden externally by the column, which fills the cylindrical area. The column is round and pierced with a cinque-foil canal. First primary radials longer than wide and together forming a funnel-shaped columnar cavity, ornamented near the top with two raised lines, forming a pentagon, with a furrow between them. Second primary radials a little wider than high, quadrangular, gradually expanding upward, and each ornamented with a small, sharp radial ridge that rises at an angle of the pentagonal ornamentation, on the first radial, and, crossing the second and third radial bifurcates at the superior angle of the third radial, from which point a broken ridge crosses each secondary radial series to the free arms. On each side of the radial ridges the plates are closely, deeply and radiately sculptured. Third primary radials shorter than the second, pentagonal, expanding upward to the lateral angles and supporting on each upper sloping side a secondary radial series.

There are four secondary radials in each of nine series, and they become smaller toward the arms, which commence, at the arm openings, with a double series of interlocking plates. They are radiately sculptured from a more or less well defined central node. One secondary radial series in our specimen consists of a single pentagonal plate which bears upon each of the upper sloping sides a tertiary radial series having three plates before reaching the double series of interlocking plates, at the base of the arms. There are, therefore, eleven arms composed at their bases of a double series of interlocking plates.

The first interradials are the larger plates of the body and have nine sides. They are deeply stellate in their ornamentation. The second interradials are more than twice as wide as high and apparently heptagonal as the two superior sloping sides of each appear to bear four small plates that separate the second and third secondary radials. These plates are followed by two plates that separate the fourth secondary radials, and upon the superior lateral sides of these plates there is a single small plate, on the side of the arm base, that appears to properly belong to the calyx. There are, therefore, ten regular interradials if the last two small plates above mentioned are to be regarded as interradials. The sutures between the intersecondary radials cannot be distinguished in our specimen, but, from the ornamentation, it is inferred there is one small plate in the first series and two in the second. No azygous area has been determined.

The vault is moderately and evenly convex, with very slightly concave interradial spaces and a small, long subcentral proboscis. It is covered with rather large polygonal plates, the ornamentation of which is destroyed in our specimens. The plates in the interradial areas are elongated and arranged in fan-like order. A horizontal furrow crosses the top of each of the last plates in the calyx, except the minute ones abutting the arm bases, and penetrates the vault at the suture between the plates of the interradial and intersecondary radial areas. Our specimens disclose four of these horizontal elongated passages in each interradial area and two in each secondary interradial area.

A glance at the vault of this species will at once distinguish it from *D. ornatus*, *D. ornatus var. asperatus* and all other described species. Beside it is remarkable for the comparatively low calyx, broad and deep basal concavity and dense stellate sculpturing of the surface.

Found in the Hamilton Group, at Louisville, Ky., and at Charleston, Indiana, and now in the collection of Wm. F. E. Gurley.

DOLATOCRINUS BULBACEUS n. sp.

Plate II, Fig. 13, basal view; Fig. 14, summit view; Fig. 15, side view.

Calyx and vault together bulbous. Calyx pentagonal from base to the arms, somewhat bowl-shaped, most expanded in the middle part, slightly constricted below the arms; columnar cavity deep. Surface marked by strong radial ridges, and a prominent node in the central part of each first interradial from which radiating ridges extend to the adjoining plates.

Basal plates almost hidden by the column though extending a little beyond it. First primary radials about as long as wide and abruptly bent in the middle, the lower part forming part of the funnel-shaped columnar cavity andthe upper end curving as abruptly upward. In the center of each there is a prominent node, from which the radial ridges arise, and which are connected by straight ridges, from one to the other, that form the pentagonal outline of the base, and on which the calyx will rest, if placed on a level surface. Second radials quadrangular, very little wider than high and sides nearly or quite parallel. Third primary radials about twice as wide as high, expanding from below to the lateral angles› pentagonal and supporting upon each of the superior sides two short, secondary radials.

The first secondary radial is much larger and wider than the second and abuts one side against a truncated corner of a first interradial and another against the secondary interradial. The second secondary radials abut against each other, are rounded externally and assume the form of the arms. The arms in each radial series are thus arranged close together, and the arm openings are directed upward. There are only ten arms, and they consist, as we infer from the commencement, of a single series of plates.

The first interradials are the larger plates of the body and have nine sides. They are convex centrally and have a prominent central node from which ridges radiate to adjoining plates. The second interradials are about half as large as the first, bear a central tubercle, are heptagonal, abut laterally upon the first secondary radials, and a small plate that separates the first and secondary radials from the plates of the vault and forms part of the base of the arms, and the two superior sides abut two interradial plates belonging to the vault.

The vault is quite convex, depressed in the interradial areas and bears a subcentral proboscis. It is covered with only a few large, polygonal plates, the surface ornamentation of which is not preserved in either of four specimens examined. There are no pores or passages that penetrate the vault between the arms and there does not seem to be any azygous side.

The general form of this species will readily distinguish it from all others that have been described, but it will be noticed that the number and arrangement of the plates of the calyx is the same as in *D. ornatus* even to the abutting of the second interradials upon the two vault plates, without pores or passages between the arms, though otherwise the vaults are quite different.

Found in the Hamilton Group, at Charleston, Indiana, and now in the collection of Wm. F. E. Gurley.

DOLATOCRINUS VENUSTUS, n. sp.

Plate II, Fig. 16, basal view; Fig. 17, side view; Fig. 18, summit view.

Calyx hemispherical, surface ornamented with radiating ridges and nodes; radial ridges sharp, prominent and interrupted at the sutures. Column large.

Basal plates almost covered by the column. First primary radials wider than long and not extending into the columnar cavity. Second primary radials a little wider than high, quadrangular, sides nearly parallel. Third primary radials a little shorter than the second, pentagonal, expanding to the lateral angles and except two, supporting upon each of the upper sloping sides a single secondary radial; two of them bear four secondary radials each.

Eight of the secondary radials bear upon each upper sloping side three tertiary radials; they grow gradually smaller, and the last ones are followed by cuneiform plates that belong to the arms. There are, therefore, eighteen arms in this species, four in each of three radial series and three in each of the other two series. The arms are composed of a single series of cuneiform plates.

The first interradials are the larger plates of the body and have nine sides. The second interradials are less than half as large as the first and they are each followed by three plates, a small one on each side at the base of the arms and a large one that unites with two plates in the interradial depression on the vault. There seem to be no intersecondary radials. There is no azygous area.

The vault is only slightly convex and moderately depressed in the interradial areas. It bears a long subcental proboscis. It is covered with large polygonal plates that are densely covered with tubercles and short spines. The tubercles are not shown in the illustrations because there are from twenty to fifty on each plate. The two interradial plates in each area that abut upon the last interradial in the calyx are elongated, and the larger plates of the vault. There are no pores or passages that penetrate the vault between the arms.

The hemispherical form and peculiar surface ornamentation distinguish this species. Beside, the number of arms is different from all related species. The number of plates and general order of their arrangement in the calyx, however, are like those in *D. ornatus* and *D. bulbaceus*, notwithstanding the wide variation in the forms of the three species.

Found in the Hamilton Group, at Charleston, Indiana, and now in the collection of Wm. F. E. Gurley.

DOLATOCRINUS AUREATUS n. sp.

Plate III, Fig. 1, basal view; Fig. 2, side view; Fig. 3, summit view.

Calyx hemispherical. Surface ornamented with radiating ridges, usually broken, and nodes; radial ridges sharp and more or less interrupted at the sutures. The sculpturing is more dense than shown in the illustrations. Column round.

Basal plates display a pentagonal rim around the column, where it enters the concavity formed by the basal plates. First primary radials wider than long and abut upon the basal plates without entering the columnar cavity. Second primary radials about twice as wide as long, quadrangular, sides nearly parallel. Third primary radials about half as long as wide, pentagonal, expanding to the lateral angles, and except three, supporting upon each of the upper sloping sides a single secondary radial; three of them bear three secondary radials each.

Seven of the secondary radials bear upon each upper sloping side two tertiary radials, the last one of which is followed by the cuneiform plates that belong to the arms. There are, therefore, seventeen arms in this species, four in each of two radial series and three in each of the other three series. The arms appear to be composed of a single series of cuneiform plates.

The first interradials are the larger plates of the body and have nine sides. The second regular interradials are about half as large as the first and they are each followed by three plates, a small one on each side at the base of the arms and a large one that unites with two large plates in the interradial depression on the vault. There are no intersecondary radials. There is, however, a distinct azygous area shown in our specimen on the side nearest the proboscis. The first and second interradials are like those in the other areas, but the second plate is followed by four or five plates (the sutures are not all distinct), that separate the arms, one-fourth more than they are separated in the other areas, and these unite with three or more plates of the vault, instead of with two as in the other areas.

The vault is moderately convex and depressed in the interradial areas. It bears a long subcentral proboscis on the azygous side. It is covered with large polygonal plates that are densely covered with tubercles. The two interradial plates, in each regular area, that abut upon the last interradial in the calyx, are elongated and the larger plates of the vault. There are no pores or passages that penetrate the vault between the arms.

This species most resembles *D. venustus*, from which it is distinguished by having seventeen instead of eighteen arms, and by having an azygous area. The surface ornamentation, too, is different, but on that ground alone we would not be justified in founding a new species in this genus, for we are satisfied the sculpturing is not uniform on specimens belonging to the same species.

Found in the Hamilton Group, at Charleston, Indiana, and now in the collection of Wm. F. E. Gurley.

DOLATOCRINUS APPROXIMATUS, n. sp.

Plate III, Fig. 4, basal view; Fig. 5, summit view; Fig. 6, side view, showing the three armed radial series.

Calyx bowl-shaped; truncated below; slightly constricted below the arm bases; pentagonal, funnel shaped columnar pit, bounded externally by a raised ridge running from a central tubercle on each first radial to a central tubercle on the adjacent first radials; column round, perforation small, cinque-foil. Surface ornamented by rather strong radial ridges commencing at the central node on the first primary radials and extending to the arms, and by radiating ridges from a central node on each plate.

Basal plates sunken and so nearly covered by the column as not to be visible externally. First primary radials about as long as wide, one-half the length being in the columnar cavity. Second radials, quadrangular, wider than long, flattened and bearing a prominent central node. Third radials, pentagonal, expanding to the lateral angles, wider than high, four of them bearing upon each upper sloping side four secondary radials and the other one bearing upon one upper sloping side four secondary radials and upon the other a single secondary radial which bears upon each of the upper sloping sides three tertiary radials. Four of the radial series thus bear two arms each and the other bears three arms, making eleven arms in this species. From the arm bases it might be inferred that the arms are composed of a double series of interlocking plates, as there are two plates at the base instead of one, but two furrows are not seen to enter the vault.

First interradials the larger plates of the calyx and have nine sides. Second interradials less than half as large as the first, hexagonal, and support three small plates in the third range, which are followed by three smaller plates that separate the arm bases and unite with the plates of the vault. Intersecondary radials two, separating the arm bases and uniting with the plates of the vault. No azygous side.

Vault moderately convex, with a subcentral proboscis and composed of convex polygonal plates. Those in the interradial areas are elongated and disposed in a fan-like arrangement. Four pores or passages enter the vault in each interradial area, and two in each intersecondary area; they are continued by a shallow furrow across the top of the last range of interradials.

This species is more nearly related to *D. lacus* than to any other that has been described. It is distinguished, however, by having eleven arms instead of ten, which, alone, we regard as of specific importance. It is further distinguished by having one more secondary radial and one more interradial in the third range, which we think is of specific importance, especially as our specimen is much smaller than any specimen of *D. lacus* we have seen. The difference in size and in surface ornamentation we do not regard as of importance, especially where, as in this case, the two species have the same general form and without careful examination might be taken one for the other. A basal view of the two species is alike.

Found in the Hamilton Group, at Louisville, Ky., and now in the collection of Wm. F. E. Gurley.

DOLATOCRINUS LINEOLATUS, n. sp.

Plate III, Fig. 7, basal view; Fig. 8, side view; Fig. 9, summit view, the small plates near the arm openings are not distinguished.

Calyx hemispherical, very slightly constricted below the arm bases, which protrude nearly horizontally. Surface ornamented with fine radiating lines, in fascicles of three, that run from a sharp prominent node, in the center of each principal plate, to the central node in each adjacent plate. Radial ridges small, sharp, continuous over the sutures and bearing a sharp node at the center of each plate. Column round, rather small.

Basal plates almost covered by the column. First primary radials a little wider than long and not extending into the columnar cavity. Second primary radials about twice as wide as long, quadrangular, sides nearly parallel. Third primary radials longer and wider than the second; about twice as wide as long; expanding to the lateral angles, pentagonal and bearing upon the upper sloping sides the secondary radials. One of them bears upon each upper sloping side three secondary radials and each of the other four bear upon one upper sloping side three secondary radials and upon the other one a single pentagonal secondary radial that bears upon each upper sloping side two tertiary radials. There are, therefore, three arms to each of four radial series and two arms to the other one, making fourteen arms in all. The arm bases project nearly horizontally. The arms are composed of a single series of cuneiform plates.

The first interradials are the larger plates of the body and have nine sides. The second interradials are more than half as large as the first and reach to the summit of the calyx. This plate in the second range is followed by three plates, the central one is the larger and unites with two plates on the vault and the lateral ones form part of the arm bases. There are no intersecondary radials. There is no azygous area.

The vault is quite convex and much depressed in the interradial areas, which is made more conspicuous by the prominence of the ambulacral areas, at the base of the arms. There is a long subcentral proboscis. The vault is covered with large polygonal plates; the smaller plates over the arm furrows near the openings in the vault are not shown in the illustrations, because the sutures are not distinct in our specimens. It is rare that they are correctly exhibited in illustrations of other species, for the same reason. The plates are covered with tubercles, those near the base of the proboscis being somewhat spinous. The two interradial plates, in each area, that abut upon the three plates in the third range of interradials belonging to the calyx, are elongated and the larger plates of the vault. There are no pores or passages that penetrate the vault between the arms.

This species is distinguished by its general form, surface ornamentation and by having fourteen arms. It is probably as nearly related to *D. venustus* as to any other species.

Found in the Hamilton Group, at Charleston, Indiana, and now in the collection of Wm. F. E. Gurley.

DOLATOCRINUS GREENEI, n. sp.

Plate III, Fig. 10, basal view; Fig. 11, side view; Fig. 12, summit view.

Calyx hemispherical, very slightly constricted below the arm bases. Surface sculptured in a variety of ways; there are prominent nodes in the central part of the larger plates from which there are radiating ridges and there are shorter radiating ridges that do not arise from the central nodes, beside scattering tubercles. The radiating ridges are interrupted at the sutures and ventricose in the middle part of the plates with a node at the center of each. Column round, medium size.

Basal plates expose a pentagonal rim around the column. First primary radials wider than long and of unequal size, two of them, on the azygous side, being much larger than the others, as shown in the upper part of Figure 10. Second primary radials only slightly wider than long, quadrangular, sides nearly parallel. Third primary radials, about the same length as the second, expand to the lateral angles, and bear upon each upper sloping side, except one, a single secondary radial. Upon one side of the radial series opposite the azygous side there are three secondary radials, the last one of which bears a cuneiform arm plate. The first secondary radials are large and bear upon each upper sloping side two tertiary radials. There are, therefore, four arms to each of four radial series and three arms in the radial series opposite the azygous area, making nineteen arms in this species. The arm bases are not large and the arms appear to be composed of a single series of cuneiform plates.

The first interradials are the larger plates of the body and have nine sides, in three of the areas; but, in the other two areas, there are two interradial plates in the first range and together they are much larger than the single first interradials. The two interradials in the first range in the two areas may be seen to abut upon the two large first primary radials in Figure 10, one plate extending below the other and one of them may be seen on the left of Figure 11. We cannot say that the two large first primary radials, followed laterally by two plates, in the first range of interradials, represent an abnormal development. We have only one specimen. The two first primary radials are substantially alike and the two peculiar interradial areas are substantially alike. If they are abnormal there is regularity about them, and they are each separated by a four-armed radial series from the three-armed series. There is only one plate in the second range, in three of the areas, and two in the other two areas. In the third range there are three plates, the central one is the larger and unites with two plates on the vault and the lateral ones form part of the arm bases. There are no intersecondary radials. There is an azygous side if we would embrace within it two radial series and three interradial areas, but there cannot be said to be a single azygous area as that term is applied in the description of crinoids.

The vault is only slightly convex but rather strongly depressed in the interradial areas between the arm bases. There is a small subcentral proboscis. The vault is covered with rather large polygonal plates, the two, in the interradial areas that abut upon the plates in the third range of the interradials, are elongated and the larger plates of the vault. All the plates bear tubercles and a few of them bear a central spine each that is surrounded with tubercles. There are no pores or passages that penetrate the vault between the arms.

This species is distinguished by its wide calyx, low vault, peculiar form, surface ornamentation and number of arms.

Found in the Hamilton Group, at Louisville, Ky., by G. K. Greene, in whose honor the specific name is proposed, and now in the collection of S. A. Miller.

Remarks.—We have described and illustrated fourteen species of *Dolatocrinus*, being all that are now known from Ohio, Indiana and Kentucky. Eleven of these are new to science, one of the others has never before been figured, and the other two are illustrated and redescribed for the purpose of showing characters not heretofore known. We call attention to the fact that no one has discovered an azygous opening in any of the species, and this important character or part of the ordinary structure of crinoids may fairly be said not to exist in this genus. *D. magnificus* and *D. aureatus* have each an azygous side to the calyx and vault and *D. greenei* has two azygous areas in the calyx, while none of the other species have an azygous side or azygous area.

D. grandis, *D. lacus*, *D. marshi*, *D. stellifer* and *D. approximatus* have orifices entering the body through the vault, between the arms, an important structure having no existence in *D. magnificus*, *D. ornatus*, *D. ornatus var. asperatus*, *D. bulbaceus*, *D. venustus*, *D. aureatus*, *D. lineolatus* or *D. greenei*, and whether or not the character belongs to *D. spinosus* is not determined. These orifices, though conspicuous in the species to which they belong, have not, so far as we are advised, been heretofore mentioned, and it would seem, therefore, appropriate for us to state more fully the structure and appearance and the possible or probable physiological functions with which they were connected.

We regard them as excurrent orifices for the reason that they cross the plates of the calyx at the summit by a furrow and enter the vault horizontally, which is inconsistent with any other hypothesis. What flowed through the orifices flowed through the channels across the thickness of the plates of the calyx, for we cannot conceive of any other utility or purpose of the furrows. Nothing could have flowed through the furrows and entered the orifices for the purpose of gaining access to the interior of the body, for there was no means of propelling anything in that direction. Endosmosis would not take place in that way.

They may have been used as conduits for the waste material that entered through the ambulacral furrows, or for the discharge of surplus water, but whatever their purpose they must have been used in the performance of some important physiological function. There would seem to be no doubt of that fact. This conclusion leads us to ask why, if they were so important to the species possessing them, did the greater number of species in the genus exist without them? The question is unanswered and at present unanswerable, because the physiological functions performed, at the seat of life, which is supposed to have been near the central part and on a level with the top of the calyx, in this genus of palaeozoic crinoids, are not known. The orifices are elongated externally and in their passage through the vault, because they are directed horizontally through the convex vault, and the elongation, therefore, depends upon the convexity of the vault in the different species.

CRINOID BASES.

Plate III, Fig. 13, superior side of an eroded base; Fig. 14, inferior side of same.

Crinoid bases are as full of pores as sponges and, when silicified, they may be cleaned with acid and made to expose the pores as shown in the illustrations. Weathered specimens, when not silicified, expose the pores, and a broken fragment will expose them also. Unaltered and finely preserved specimens do not expose the pores externally. The column is inserted in an obconoidal cavity in the base and the pores radiate from this cavity in all directions to the farthest extremities of the base. They are rarely larger than an ordinary sewing needle, and generally less in size, but so numerous that the interspaces have a diameter but little more than the diameter of the pores. The radiating pores are more or less sinuous and accommodated to the irregularities of the base.

These pores, as we suppose, were connected with the columnar canal and through them the material passed that formed the base. The histogenesis of the base may be compared with the formation and development of the bones of an animal. The mucous or fluid substance, that contained the material for the base, passed through the columnar canal into the pores of the base and was deposited in a softer state than it afterward assumed. In this way the base increased in size with the growth of the animal, and was made to fill the inequalities of the surface, to which it attached, and to extend over the border so as to form hooks or anchors of support. The nutrition for the formation of the organic structure of the base was furnished in the same manner that it was supplied for all other parts of the skeleton of a crinoid. The pores of the base were channels for nutrition and were appropriated exclusively to the construction and support of it.

The plates of a crinoid column were enlarged with the growth of the animal, as bones and shells are increased in size; but new plates seem to have originated exclusively at the lower end, or within the obconoidal cavity, in the base, at the end of the column; none appear to have been intercalated between older plates and none were added at the superior end of the column. The columnar canal was, therefore, a channel for nutrition, and nothing passed into it except the digested and reparatory juices for the columnar cords or tendons and the skeletal plates and base.

The base illustrated is from the Hamilton Group, at Louisville, Ky., but it does not differ in organic texture or structure from bases found in other groups of rocks.

FAMILY ICHTHYOCRINIDAE.

LECANOCRINUS OSWEGOENSIS n. sp.

Plate III, Fig. 15, view on the right of the ray on the azygous side; Fig. 16, azygous side; Fig. 17, view of the ray between the azygous area and the area shown in Fig. 15, and which bears four primary radials.

Species small, subelliptical in general outline. Calyx obconoidal, bulged on the right of the azygous area, truncated for a small, round column, which is composed of thin plates, exposing the serrated edges for the union of the plates, and having a very small columnar canal. Plates of the calyx slightly convex and covered with granules; sutures distinct.

The three basals form a low pentagonal cup, about twice the diameter of the column. The subradials are of unequal size, the one below the azygous area is the larger and has seven sides, two of the others are hexagonal and two pentagonal. There are four primary radials in the series on the right of the azygous area and three in each of the other series. The first primary radials are unequal in size, the one on the right of the azygous area being the smaller and having only five sides, the others are hexagonal or heptagonal, depending upon whether they are truncated upon one or both superior lateral angles by the first interradials. The second primary radials are short and wide and of very unequal size, the one on the right of the azygous area is the larger and is hexagonal, the others are subquadrangular, but when a superior lateral angle is truncated by a second interradial they become pentagonal. Four of the third primary radials are short, wide, pentagonal and bear upon the upper sloping sides the secondary radials or free arms; the other third primary radial is short, wide, subquadrangular though slightly truncated at the superior lateral angle on the azygous side, so as to make it pentagonal; and it is then followed by a fourth primary radial which is pentagonal and axillary, and bears upon the upper sloping side the secondary radials or free arms. The arms preserved in our specimen have three short, secondary radials, in each, the last one of which is pentagonal and supports, on each upper sloping side, a third series of plates.

There are two small regular interradials in each area, one above the other; the first one separates the second and third primary radials, in each series, in some of the areas, it truncates the superior angles of the first primary radials, in others it does not extend so low. The first azygous plate is rather larger than the first primary radial on the right and has eight sides; it truncates a subradial, abuts upon three primary radials on the right, though the third one truncates the angle only slightly, two on the left, and is followed by two plates on the superior side, the one on the left being quite small. The larger plate in the second range is succeeded by a small plate on the right, which is all that is preserved in our specimen, but the facet for another plate in the middle part is well preserved. The azygous area, therefore, has five or more plates.

This species is readily distinguished from all others by the general form, regular interradial plates, azygous interradials and series of four primary radials in one of the rays. It is wholly unnecessary to compare it with any of them, though it clearly belongs to this genus.

Found in the Niagara Group, at Oswego, Illinois, and now in the collection of Wm. F. E. Gurley.

FAMILY ACTINOCRINIDAE.

MEGISTOCRINUS EXPANSUS n. sp.

Plate III, Fig. 18, basal view of a large specimen; Fig. 19, summit view of the same; Fig. 20, side view of the same; Fig. 21, basal view of a small specimen showing the commencement of the horizontal arms.

Calyx very shallow; broadly basin-shaped; from three to five times as wide as high; columnar cavity, evenly concave, commencing from about the middle of the second radials, the superior part of which curve upward; the calyx continues to expand from the second radials to the arms, expanding more rapidly as the arms are approached. The arms are directed horizontally. The column is round and of medium size. The vault is one-half higher than the calyx and has twice the capacity.

The basal plates have an hexagonal outline, about one-half wider than the diameter of the column. The first primary radials abutting on a single basal plate are hexagonal, those abutting on two basals are heptagonal. The second primary radials are a little larger than the first and hexagonal. The third primary radials are about the size of the first, pentagonal, and support upon each upper sloping side secondary radials.

The external surfaces of all the plates covering the three specimens at hand, one of them being intermediate in size between the two illustrated, are more or less eroded or disintegrated. The best preserved plates are beveled at the sutures, and it is, therefore, believed that specimens having a well preserved external surface will show distinctly the outlines of all the plates. In our specimens the sutures of the secondary and tertiary radials and those of the vault are generally obscure; some of them are, however, distinct. This is the reason the illustrations are not made to show all the plates, and, for the same reason, there is a little doubt about the number and shape of some of the plates just below the top of the calyx.

The first secondary radials are nearly as large as the third primary radials. In one of the lateral rays on each side there are no tertiary radials. In each of these two rays the second secondary radials are somewhat smaller than the first and extend to the lower part of the commencement of the enlargement for the arms. There are three or four more plates in each series, forming the base of the arms, before the arms become free. This gives us five or six secondary radials in each series, and two arms to each of these rays. In the other three rays there is only a single secondary radial in each. It is pentagonal and supports upon each of the upper sloping sides tertiary radials. There are four or five tertiary radials in each series, the last three or four of which form the base of the arms before they become free. The last two or three plates in each of the radial series are more or less cuneiform before the arms become free. There are, therefore, four arms to each of three rays and two arms to each of the other two rays, making in all sixteen arms to this species. The arms are composed of a single series of cuneiform plates.

In the interradial areas there is one hexagonal plate separating the second primary radials, and two plates in the second range separating the third primary radials, each of which is about the size of the primary radials. There are three plates in the third range, three in the fourth and three in the fifth; the last form a sharp ridge between the arm bases, which rises above the vault plates, that abut against it. In the intersecondary areas there is one plate in the first range and two in the second; the latter form a sharp ridge between the arm bases, which rises above the vault plates that abut against it. First azygous plate in line with the first primary radials and of the same size; it is followed by three plates of the same size as the first radials. Above these the area and arrangement of the plates is very much like the regular areas, with about one more plate in each range.

The vault bears a large central plate with a big conical spine. There is also a spinous plate over the junction of the ambulacral furrows in each series, making six spinous plates on the vault. The plates that cover the vault are polygonal and of very unequal size. There is an orifice on the azygous side of the central spine. The ambulacral areas are raised into rounded ridges and the interradial areas are depressed between the arms. The surface of the plates, in our specimens, is destroyed and the larger number of the sutures are not discernable.

This species is distinguished, by its general form, from all others. The broad shallow calyx, high convex vault, and horizontal arms will alone distinguish it. The number and arrangement of the arms is also a distinguishing feature as well as the surface of the plates, for most species from rocks of the same geological age, have highly convex or subspinous plates in the calyx.

Found in the Hamilton Group, at Louisville, Ky., and now in the collections of the anthors.

AN INTERESTING LETTER.

There is a letter, on file in the State Museum of Natural History of Illinois, belonging to the Geological Department, from Charles Wachsmuth, dated, at Burlington, Iowa, August 9, 1892, containing the following paragraph:

"I have described the *Eucalyptocrinus lindahli* and have sent the description, together with that of some other new species from the Niagara Group to the American Geologist for early publication, to secure priority, as I am aware that S. A. Miller will be out this fall, on some of the same species. This, of course, is confidential, for I do not want Miller to know it."

There was no more sympathizing place, for the publication of such material, than the American Geologist, a journal that never aspires to a higher level in scientific matters.

PLATE I.

Page.

Dolatocrinus magnificus, n. sp. 5

Fig. 1. Basal view of a calyx somewhat injured near middle part.
Fig. 2. Vault, a part being broken away.
Fig. 3. Lateral view of calyx, showing six-armed ray and height of vault.

Dolatocrinus spinosus, n. sp. 8

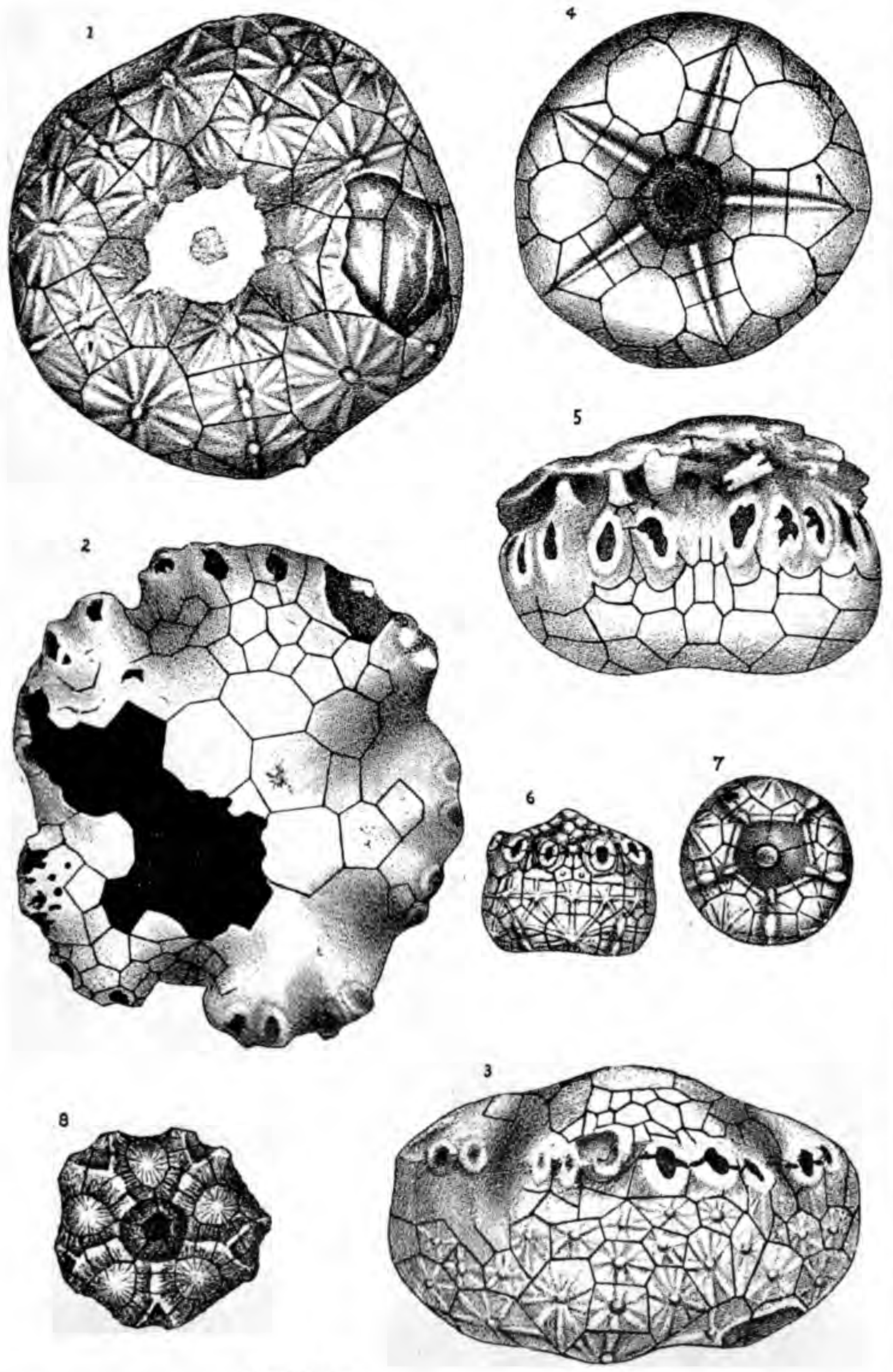
Fig. 4. Basal view of a calyx.
Fig. 5. Lateral view of calyx showing some of the spines on the plates of the vault.

Dolatocrinus lacus, Lyon 9

Fig. 6. Lateral view of a calyx.
Fig. 7. Basal view.

Dolatocrinus marshi, Lyon 11

Fig. 8. Basal view of a calyx.



H. HUNT, DEL.

PLATE II.

PAGE.

DOLATOCRINUS GRANDIS, n. sp. 14
Fig. 1. Basal view of a calyx.
Fig. 2. Vault, somewhat broken away near the center.
Fig. 3. Lateral view of calyx.

DOLATOCRINUS ORNATUS VAR. ASPERATUS, n. *var* 16
Fig. 4. Basal view of a calyx.
Fig. 5. Vault.
Fig. 6. Lateral view of calyx.

DOLATOCRINUS ORNATUS, Meek 18
Fig. 7. Basal view of a calyx.
Fig. 8. Vault.
Fig. 9. Lateral view of calyx.

DOLATOCRINUS STELLIFER, n. sp 20
Fig. 10. Basal view of a calyx.
Fig. 11. Vault.
Fig. 12. Lateral view of a fragmentary calyx, showing interior of basals.

DOLATOCRINUS BULBACEUS, n. sp 22
Fig. 13. Basal view of a calyx.
Fig. 14. Vault.
Fig 15. Lateral view of calyx.

DOLATOCRINUS VENUSTUS, n. sp 23
Fig. 16. Basal view of a calyx.
Fig. 17. Lateral view of calyx.
Fig. 18. Vault.

ILL. STATE MUS. OF NAT. HIST.

Bulletin No. 4. **Plate II.**

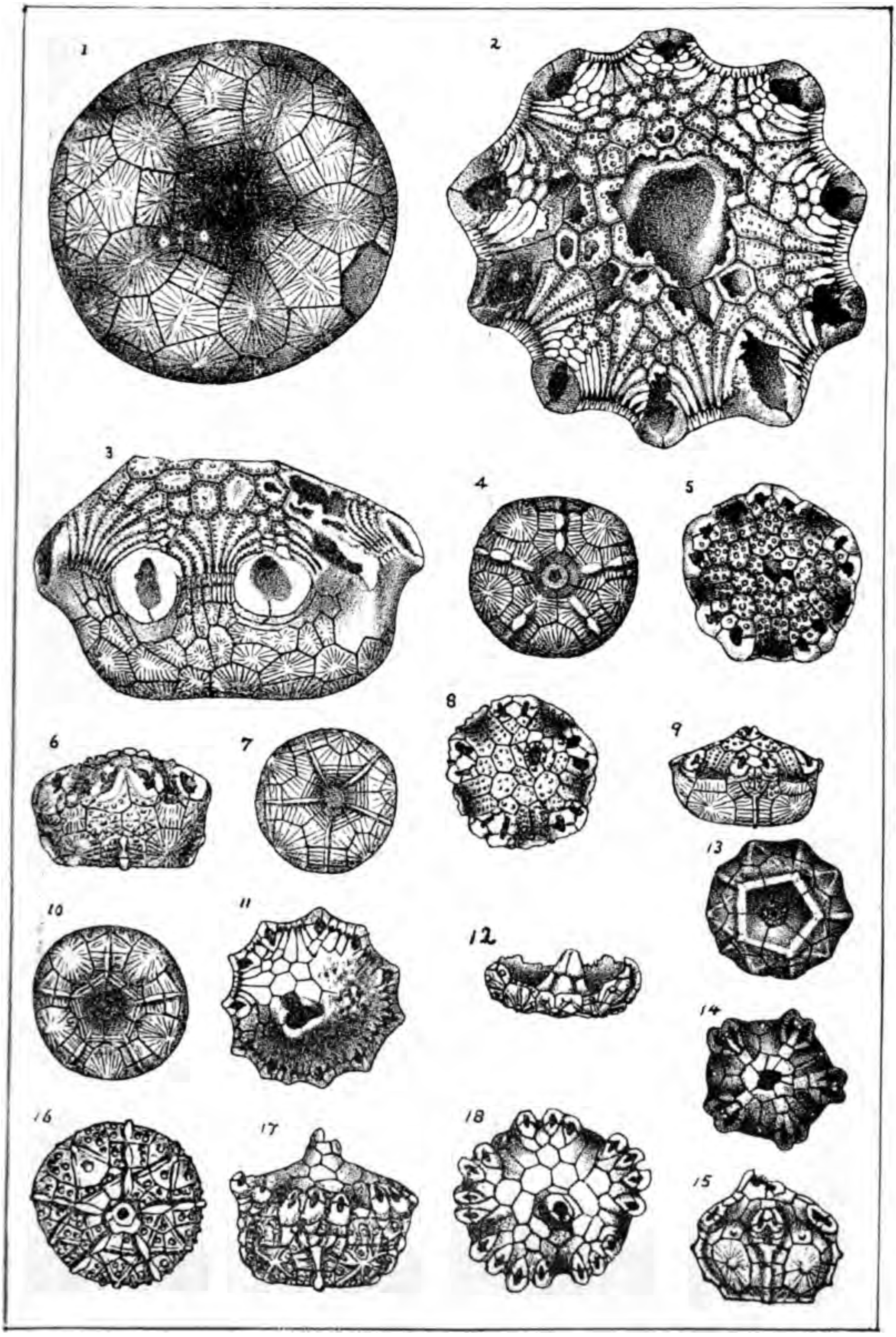


PLATE III.

PAGE.

DOLATOCRINUS AUREATUS, n. sp. 24
Fig. 1. Basal view of a calyx.
Fig. 2. Lateral view of calyx.
Fig. 3. Vault.

DOLATOCRINUS APPROXIMATUS, n. sp. 25
Fig. 4. Basal view of a calyx.
Fig. 5. Vault.
Fig. 6. Lateral view of calyx.

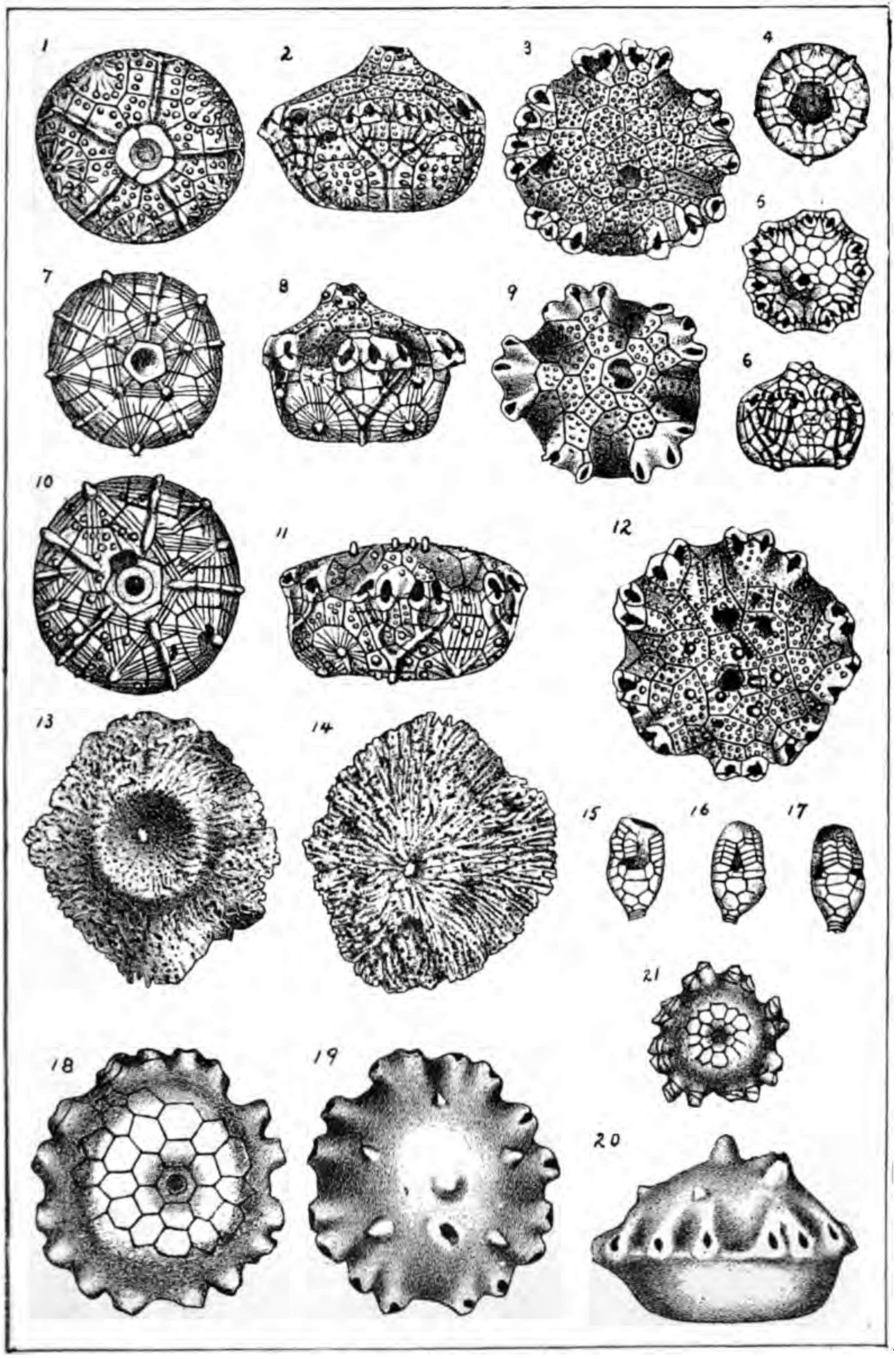
DOLATOCRINUS LINEOLATUS, n. sp. 27
Fig. 7. Basal view of a calyx.
Fig. 8. Lateral view of calyx.
Fig. 9. Vault.

DOLATOCRINUS GREENEI, n. sp. 28
Fig. 10. Basal view of a calyx.
Fig. 11. Lateral view of calyx.
Fig. 12. Vault.

CRINOID BASE 31
Fig. 13. Superior side of an eroded base.
Fig. 14. Inferior side of same.

LECANOCRINUS OSWEGOENSIS, n. sp 33
Fig. 15. Lateral view showing area on right of the ray on azygous side.
Fig. 16. Azygous side view.
Fig. 17. View of the ray between the azygous area and the area shown in Fig. 15.

MEGISTOCRINUS EXPANSUS, n. sp. 35
Fig. 18. Basal view of a calyx.
Fig. 19. Vault.
Fig. 20. Lateral view.
Fig. 21. Basal view of a smaller specimen, showing the commencement of the horizontal arms.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BULLETIN NO. 5

OF THE

ILLINOIS STATE MUSEUM

OF

NATURAL HISTORY

NEW GENERA AND SPECIES OF ECHINODERMATA.

By S. A. MILLER and WM. F. E. GURLEY.

SPRINGFIELD, ILLINOIS,
December 20, 1894.

SPRINGFIELD, ILL.
ED. F. HARTMAN, STATE PRINTER.
1894.

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State Geologist and Curator.

NEW GENERA AND SPECIES OF ECHINODERMATA.

BY S. A. MILLER AND WM. F. E. GURLEY.

SUBKINGDOM ECHINODERMATA.

CLASS CRINOIDEA.

ORDER CYSTOIDEA.

FAMILY HOLOCYSTIDÆ.

HOLOCYSTITES GYRINUS, n. sp.

Plate I, Fig. 1, ventral view; Fig. 2, posterior view; Fig. 3, summit view.

This species is large, and if the almost perfect specimen, which we have illustrated, possesses the normal form of complete development, then it became free in the later stages of growth, for a scar at the terminal point, indicates an attachment to some foreign object in a younger state. The specimen is a little depressed dorso-ventrally. It is broad and rounded at the summit, followed immediately below by a sac-like swelling, from which it is continued in an obconoidal form until it terminates in an obtuse point. The fanciful resemblance, in the general outline, to a tadpole suggested the specific name.

Commencing at the base or lower end, there is a solid obconoidal piece nearly as long as its greater diameter, which is followed by a range of eight unequal, irregular, and more or less elongated plates. Two plates are inserted between this range and the next on the right part of the ventral side. There are eleven large and elongated plates in the second range, and three plates are inserted on the posterior side, between it and the next range. There are thirteen large, irregular and elongated plates in the third range and nineteen plates in the fourth range. The fifth range consists of plates more irregular in their order of arrangement and still more

arm, the furrow runs up to the base of the arm where it does not cut one-fourth of the thickness of the plate, and where the pores upon the sides appear to differ from the other pores that penetrate the plate only by being arranged externally in two lines. The physiological functions of this furrow are unknown.

We do not desire to be understood as laying any stress on the word *arms* used above, for so far, no arms, in the true sense, have been found in this genus. Instead of that we have had ambulacral spines, in some species, and in others no indications of spines. In this species there may have been only spines instead of arms possessing any kind of movement. All of the plates are poriferous, some much more densely poriferous than others; even the basal plate is poriferous. The pores generally penetrate the plates in pairs.

This is a remarkable species, on account of the Y-shaped furrow that connects the three arm or spine bases, and it is distinguished from all others by its peculiar form, size and the plates covering the body.

Found by J. F. Hammell in the lower part of the Niagara Group, in Jefferson county, Indiana, and now in his collection.

HOLOCYSTITES SPLENDENS, n. sp.

Plate I, Fig. 7, left anterior view or most ventricose side; Fig. 8, right posterior view or least ventricose side; Fig. 9, summit view.

This species is rather below medium size, balloon shaped or somewhat pear-shaped and our specimen is most ventricose on the left anterior side. It was sessile and the cicatrix for attachment is plainly preserved. The whole body is pustulose and every pustule is pierced by a pair of pores. There are also a number of large round cavities or hemispherical depressions irregularly distributed over the body, as shown in the illustrations, the purpose of which is wholly unknown. It has been supposed that they are marks of disease, and that the fact that the whole order of cystideans, soon after their great abundance in the Niagara Group, became extinct, gave color to the supposition, but we have no evidence that they are marks of disease.

Commencing at the lower end, we have, first, a small, round piece that attached to some foreign object, but which is papillose and pierced with pores just as the plates are above. It is variable in size. Above the fifth range the plates are not disposed in ranges nor in any other defined order, and differ so much in size and shape, that one can hardly say how many ranges they would make if disposed in some order. We would estimate, if they were in ranges, there are above the fifth range and below the mouth about seven or eight ranges; or between the basal piece and the mouth about twelve or thirteen ranges. Our specimen is most ventricose on the right side, and there is a base of a young cystidean at the lower side of the mouth and another immediately below one of the arm bases and some smaller bases on other parts of the body.

Looking at Fig. 3, the mouth may be seen on the upper side of the figure, two arm bases on the right and one on the left, connected by a Y shaped ambulacral furrow, and in the central part, between the mouth and the ambulacral furrow, what has been supposed to be the small anal opening. The mouth is on the margin of the anterior end and appears to have been surrounded by six plates, but the cystidean base covers the lower side of it, and hence, possibly, there are seven plates. The anal (?) opening is small and at the summit of a cone which is on the line of two plates. The ambulacral furrow is at the extreme summit and connects the three arm bases by following the sutures between the plates; the plates are denticulated or united by a zigzag line at the bottom of the furrow. Each plate that supports an arm is thickened and prominent and the ambulacral furrow is continued across this plate to the top of the prominence, where the cicatrix shows the place to which the arm was attached. The arms are not preserved. On each side near the bottom of the ambulacral furrow there is a row of pores, but a free plate of the same character from the same or a similar species, when examined from below, does not show these pores in lines, nor can they be distinguished from the other pores that penetrate the plate from all sides. The ambulacral furrow, therefore, is not homologous with the ambulacral furrows of either crinoids or blastoids. There is no reason to suppose that it was a food groove, was covered with minute plates, or was furnished with pinnules. It appears as a triangular furrow cut only half way through the plates, and where following the suture lines of plates, the plates are more firmly joined than elesewhere by the denticulated edges, but when it enters upon a plate that bears an but the openings are unknown. Column comparatively large composed of thin plates and tapering as in *Steleocystites*. Type B. *Wetherbyi*.

BELEMNOCYSTITES WETHERBYI, n. sp.

Plate I, Fig. 4, dorsal side of a specimen with part of the column attached; Fig. 5, dorsal side of another specimen with column and part of the plates broken off; Fig. 6, ventral side of same, part of the plates only being distinguishable.

In 1881 Professor A. G. Wetherby, in an article entitled "Descriptions of New Fossils from the Lower Silurian and Subcarboniferous Rocks of Kentucky," published in Jour. Cin. Soc. Nat. Hist., vol. 4, p. 177, pl. V, figs. 2 and *2a*, called attention to a "new genus and species" of cystideans, without attempting to give it a name or determine its affinities. Fig. 4 is a reproduction of his figure 2, which is, evidently, the dorsal side of the specimen. He said of it: "The column is round and tapers rapidly. The peculiar character of this anomalous fossil is the presence of a single arm, originating between two large plates which form the apex of the body on the (ventral) side. Seven plates of the arm are shown. Near it, upon the left side, as shown in the figure, is a small tubercle, evidently formed by valvular plates now silicified so as to obscure their arrangement." Our specimen, as shown in figures 5 and 6, is just like his, except the lower part is broken away, and we have attempted to give a better view of the ventral side than is shown in his figure *2a*. We have given him the honor of the specific name.

Body compressed, convex on each side, within the marginal rim of plates, outline subovoid, truncated at the base for the attachment of a large column, which is composed of thin plates and tapers rapidly.

There are nine plates in the marginal rim, not including the two which abut upon the column. Five on one side and four on the other. These plates are large and sutures distinct. The sutures are exactly opposite each other on the two sides and are plainly shown curving over the margin, which is thin and sharp. This peculiar rim of plates increases in thickness on the ventral side toward the central part of the body, which renders it probable that they are furrowed within so that a transverse section would be somewhat V-shaped, though they are depressed on the dorsal side. In no part of this rim is there any evidence of pectinated rhombs, pores or arms.

On the dorsal side of our specimen, there are only five plates preserved within the marginal rim, but figure 4 shows there are seven plates, two of which abut upon the column. The three superior plates are subconical. The outer surface is destroyed by silicification.

On the ventral side, there are evidently more plates within the marginal rim, but part of them cannot be distinguished, in our specimen, because the silicification has obscured the sutures. The ventral side is much more convex than the dorsal. The single arm to which Wetherby referred arises between plates, within the marginal rim of plates, and not from the apex of the body by any means. This is shown by his illustration as well as by ours. We cannot distinguish the arm plates, in our specimen, but the projection seems to be that of an arm. We are not able to distinguish any openings, but the tubercle, to which Wetherby referred, is on the left of what we have called the column, though it is not shown in our illustration, and we are not sure that it indicates anything beyond the convexity of the plate.

Found in the Trenton Group, in Mercer county, Kentucky, and now in the collection of Wm. F. E. Gurley.

FAMILY CARYOCRINIDÆ.

CARYOCRINUS ELLIPTICUS, n. sp.

Plate II, Fig. 13, anterior side view; Fig. 14, summit view.

Species below medium size, subelliptical in outline, somewhat angular below, but round in the central part. Sharp ridges radiate from the center of the plates to each angle, except on the basal plates, where a sharp ridge runs from each of the two superior angles on each plate, to the point of columnar attachment. There is a single row of pores on each side of these angular ridges, but none elsewhere on the plates.

The four basal plates are of unequal size and form a cup less than one-third the length of the body. The strong longitudinal ridges give it an hexagonal outline. The base is rather deeply excavated for the insertion of the column. The six plates in the second range are of unequal size and the larger ones follow the smaller basal plates so that the symmetry of the body is restored, two are pentagonal, two hexagonal and two heptagonal. These plates bear sharp ridges radiating from the center to each angle. There are eight plates in the third range of unequal size and different in outline. The summit is covered with very convex plates. The mouth is near the margin, slightly elevated and surrounded by four convex plates, one of which is much larger than the others. The central plate is heptagonal and surrounded by seven plates. There are several smaller plates on the vault. There are nine arm openings to the vault.

This species is probably more nearly related to *C. indianensis* than to any other described species. It differs, however, in the general form and in the absence of the constriction below the arms. The third range of plates are not alike in the two species and the vaults are different. That species has twenty-one arms disposed in clusters; this one has only nine, and they are not in clusters. The plates of the vault in that species bear pores and pustules, while in this the plates are smooth and convex. There are pores and pustules between the radiating lines in that species and there are none in this. The surface ornamentation will readily distinguish the species as well as the general form.

The specimen illustrated is from the Niagara Group, at Osgood, Indiana, and is in the collection of S. A. Miller. Four specimens are in the collection of Wm. F. E. Gurley, from the Niagara Group, at St. Paul, Indiana, and they seem to differ only in bearing higher and sharper radiating lines.

CARYOCRINUS BULBULUS, n. sp.

Plate II, Fig. 15, anterior side view showing mouth at the summit and arm openings laterally; Fig. 16, posterior view; Fig. 17, summit view; Fig. 18, basal view of same.

Body bulbous, or subovoid, subpyramidal from the column to the middle of the second range of plates, where, by reason of the central protuberances on the plates, it is hexagonal; above this, it is less angular, but the mouth is produced above the rest of the summit, which is somewhat flattened behind the mouth. The surface, as it appears on our two specimens, one of which is unaltered limestone and the other silicified, is smooth. There are no radiating lines or ridges, granules or pustules and there are no pores that can be discovered with an ordinary magnifier.

The four plates, in the first range, form a subhexagonal cup about one-third of the length of the body, which has a small hemispherical depression at the bottom for the insertion of a column. The six plates in the second range are of unequal size, four are hexagonal, one pentagonal and one heptagonal; all are longer than wide, except the heptagonal plate, which is fully as wide as long. Each plate is subpyramidal externally, that is, produced centrally in the form of a node, which gives to the central part of the body its hexagonal outline. A cast, however, would not, probably, preserve this hexagonal outline and might be perfectly round.

There are eight plates in the third range of unequal size and different in outline. Two hexagonal plates stand nearly upright and abut upon the mouth, with their superior angles between the mouth and an arm opening on either side. Six of the plates rest between the superior lateral sides of the plates of the second range and two of them, each, truncate a single plate in the second range. The latter two are the smaller plates in the range. All of the plates of this range except where truncated by the mouth and arm openings abut upon the plates of the vault.

There is a subcentral plate on the vault, but the sutures between the plates in our specimens are not distinct, and we are not certain, therefore, as to the number of plates surrounding it; apparently there are only six, but probably there are seven. There are only six armholes that are clearly distinguishable on the limestone specimen, but there appear to be nine in the silicified specimen.

This species is widely separated from all hitherto described, but there is no doubt about the generic relations.

Found in the Niagara Group, in Wayne county, Tennessee, and now in the collection of Wm. F. E. Gurley.

ORDER AGELACRINOIDEA.

FAMILY HEMICYSTIDÆ.

AESIOCYSTITES, n. gen.

[*Ety. aisios*, auspicious, coming at a good time; *Kustis*, bladder.]

Body highly convex or hemispherical; free, not parasitic. We say free, because the plates preserved in our specimens are continued over the margin and part of the truncated side, and the arms also curve over the margin before they terminate. The truncated side is depressed in our specimens and is not preserved so as to offer an opportunity for an intelligent description. Plates of the interbrachial areas non-imbricating and not coalescing with the outer plates of the arms. Arms five, very large, highly convex, radiating from the center and curving over the margin before they terminate. They are composed externally of a double series of alternating and interlocking plates; when these plates are removed deep gutters are disclosed, which are angular at the bottom, and unite in an elliptical hole at the center, which connects with the visceral cavity below. The ambulacral furrows and central orifice are completely covered with the alternating and interlocking arm plates. One interbrachial area is larger than the others and the anal or ovarian pyramid is situated in it, eccentrically, approaching the margin.

This genus is readily distinguished from *Hemicystites*, which is a parasitic genus, composed of imbricating plates that coalesce with the arms, which are limited by a marginal rim of plates. Type *Aesiocystites priscus*.

AESIOCYSTITES PRISCUS, n. sp.

Plate II, Fig. 10, summit view with the outer plates of the arms silicified and showing the position of the anal or ovarian pyramid, Fig. 11, summit view with the arm plates removed and disclosing the arm furrows, the central orifice and the position of the anal or ovarian pyramid; Fig. 12, lateral view from which the external plates of the arms have been partly removed and showing the interbrachial plates.

The specimens upon which this genus and species are founded are silicified and the sutures between the plates more or less destroyed. The under side of all of them is broken in or damaged so that a full knowledge of it cannot be obtained.

The general form is hemispherical, with truncated margin rounded and radial ridges elevated and angular. It is composed of polygonal and non-imbricating plates, the largest of which are in the interbrachial areas. The interbrachial areas are distinctly defined on the convex side and the plates curve over the inferior margin and on the truncated side without interruption. The arms are very large, highly convex, and angular on the summit. They radiate from the center in such manner as to leave one interradial area larger than the others, with an arm directly opposite, and this lengthens the central arm elevation toward the two arms upon each side. The arms bend over the margin and then gently curve and terminate on the truncated side. Externally they consist of a double series of short alternating and interlocking plates, which cover large, deep and angular ambulacral furrows. The form of the plates in the bottom of the ambulacral furrows is not determined. The central orifice, from which the ambulacral furrows radiate, is sub-elliptical in outline, being lengthened with the central arm elevation and covered externally with the arm plates. The large area above described is the azygous area and the anal or ovarian pyramid and orifice is situated in it, eccentrically, near the margin

This species is founded upon four specimens, in two of which the external arm plates are removed, and one of these preserves a large part of the truncated side showing the curving and terminating ends of the arms. One of the other specimens shows part of the interlocking arm plates and the other shows the covering of the arm furrows almost complete. Whether there was a gaping of the arm plates at the ends of the rays or not is not determined, but it is quite probable that they did, as such is frequently found to be the case in Hemicystites.

Found in the Trenton Group, in Mercer county, Kentucky, and now in the collection of Wm. F. E. Gurley.

FAMILY AGELACRINIDÆ.

AGELACRINUS LEGRANDENSIS, n. sp.

Plate III, Fig. 13, two specimens, natural size, the smaller one not as well preserved as the larger one; Fig. 14, same magnified two diameters.

The species in this genus seem to vary greatly in size, and we have no doubt the two specimens illustrated belong to the same species though the smaller one is not so well preserved as the larger and may not furnish all the evidence necessary to warrant a satisfactory conclusion in this respect. It is also quite probable that the larger specimen does not reach the maximum size of the species.

The body is circular and only slightly convex. The outer rim is composed of numerous small, squamiform, imbricating plates, those upon the outer margin of it are so minute as to be almost granular. The plates of the disc within the outer rim are also squamiform and imbricating and somewhat larger than any of the plates in the outer rim. There are only four arms, three of them curve slightly to the right and one to the left. The arms are slender and each consists of an angular ridge, composed of interlocking plates, and terminates after curving slightly on the inside of the outer rim. The central part from which the arms radiate is more convex than any other part of the body, but the plates are so small that no peculiar structure is discernable. The specimens are somewhat injured in the region of the aperture and apparently it is not at the center between the sinistral and dextral arms, but between that point and the central elevation.

AESIOCYSTITES PRISCUS, n. sp.

Plate II, Fig. 10, summit view with the outer plates of the arms silicified and showing the position of the anal or ovarian pyramid, Fig. 11, summit view with the arm plates removed and disclosing the arm furrows, the central orifice and the position of the anal or ovarian pyramid; Fig. 12, lateral view from which the external plates of the arms have been partly removed and showing the interbrachial plates.

The specimens upon which this genus and species are founded are silicified and the sutures between the plates more or less destroyed. The under side of all of them is broken in or damaged so that a full knowledge of it cannot be obtained.

The general form is hemispherical, with truncated margin rounded and radial ridges elevated and angular. It is composed of polygonal and non-imbricating plates, the largest of which are in the interbrachial areas. The interbrachial areas are distinctly defined on the convex side and the plates curve over the inferior margin and on the truncated side without interruption. The arms are very large, highly convex, and angular on the summit. They radiate from the center in such manner as to leave one interradial area larger than the others, with an arm directly opposite, and this lengthens the central arm elevation toward the two arms upon each side. The arms bend over the margin and then gently curve and terminate on the truncated side. Externally they consist of a double series of short alternating and interlocking plates, which cover large, deep and angular ambulacral furrows. The form of the plates in the bottom of the ambulacral furrows is not determined. The central orifice, from which the ambulacral furrows radiate, is sub-elliptical in outline, being lengthened with the central arm elevation and covered externally with the arm plates. The large area above described is the azygous area and the anal or ovarian pyramid and orifice is situated in it, eccentrically, near the margin

This species is founded upon four specimens, in two of which the external arm plates are removed, and one of these preserves

FAMILY RHODOCRINIDÆ.

ARCHÆOCRINUS PECULIARIS, n. sp.

Plate II, Fig. 1, lateral view of a specimen slightly compressed laterally; Fig. 2, azygous view of same, showing the curved radial series with an azygous plate over the first radial; Fig. 3, basal view of same.

Species large. Calyx globose; greatest diameter about the top of the second primary radials and very slightly exceeding the height; constricted below the arms; plates convex and free from radial ridges; sutures beveled; surface granular.

Basals small, deep within the calyx and covered by the column. Subradials longer than wide and truncated at the superior ends by the first interradials. The inferior ends curve abruptly into the columnar cavity and are notched so as to give a subpentagonal outline to the columnar cavity, which indicates that the column (which is unknown) is pentagonal. These plates curve gently upward so that the calyx will rest below the middle and show half the length in a side view.

Four of the first primary radials are pentagonal, about equal in size, and about as wide as high. The other one is hexagonal, has unequal sides and is the largest plate in the calyx. It is on the left of the azygous area and supports on its upper side an azygous plate and upon the left superior lateral side the second primary radial, as shown in the illustration.

Four of the second primary radials are hexagonal, about the same size as the four first primary radials and nearly as high as wide. The other one is pentagonal, somewhat smaller and inclined so as to present a horizontal upper face for the support of the third primary radial, as shown in figure 2.

Third primary radials very little more than half as large as the second, smaller than the adjoining interradials, of about equal size, about as wide as high, pentagonal, and support on each upper sloping side a single secondary radial. Secondary radials a little more than half as large as the third primary radials, hexagonal and support upon the inner upper sloping sides a secondary interradial, and upon the superior faces a single tertiary radial, and upon the outer upper sloping sides two tertiary radials (?). Our specimen is not preserved beyond these plates. There are, therefore, twenty (?) arms arising from the calyx.

This species is about the size of *Agelacrinus blairi* but the plates are smaller and the body is probably less convex. It is the only species yet known from the rocks of the Kinderhook Group, and also the only one that bears four arms.

Found in the Kinderhook Group at LeGrand, Iowa, and now in the collection of Wm. F. E. Gurley.

AGELACRINUS PULASKIENSIS, n. sp.

Plate III, Fig. 18, a specimen showing the ovariou or anal pyramid.

Species large, body circular and with more than the usual convexity. The outer rim is composed of numerous large squamiform plates, that imbricate inward from the periphery, those near the margin being the smaller, as in all other known species in this genus. The plates of the disc within the outer rim and between the arms are large and imbricating, though a few of them appear to be very slightly imbricating. There are five very long, slender, curving arms, forming convex ridges, four of them sinistral and one dextral. The central part of the arms, so far as shown in our specimen, consists of a double row of interlocking plates, which are supported by large plates laterally, that rise nearly as high as the central plates. The central part from which the arms radiate is more convex than any other part of the body and is covered with numerous small plates. The ovarian or anal aperture is situated about the middle of the largest interbrachial area and surrounded by the dextral and one sinistral arm. It is a depressed convex, circular prominence covered with twelve cuneiform plates. The surface of the plates is finely granular.

This species has some resemblance to *Agelacrinus cincinnatiensis*, but the arms are longer, body more convex, ovarian aperture larger and covered with more large plates.

Found in the Kaskaskia Group in Pulaski County, Kentucky, and now in collection of Wm. F. E. Gurley.

ARCHÆOCRINUS ASPERATUS, n. sp.

Plate II, Fig. 7, basal view, azygous side below; Fig. 8, summit view, azygous side below and matrix covering some of the plates on the right; Fig. 9, azygous side view.

Species medium size. Calyx bowl-shaped, subpentagonal in outline, more than twice as wide as high; radial ridges interrupted at the sutures; plates subspinous or very convex and more or less sculptured; surface granular; columnar cavity wide, deep, and sculptured so as to indicate a pentagonal column.

Basals small, deep within the calyx, but not covered by the column, in fact, the column enters the cone formed by the basals leaving the basals abutting the subradials outside the circumference of the column. Subradials large, longer than wide, abruptly bent into the columnar cavity and upward between the radials, leaving a transverse ridge across the middle part of each, from each end of which a radial ridge arises, that unites with another in the central part of each first primary radial. The calyx will rest upon these ridges as the sculpturing is deep. The azygous subradial is octagonal the others are heptagonal, the shorter sides abut upon the basals and adjacent subradials, the longer sides support the radial series while each is rather broadly truncated at the superior end.

Three of the first primary radials are pentagonal, the other two, on the right of the azygous area, are hexagonal. They are all wider than high, the shorter sides abut the interradials, the longer sides the subradials and second radials. The superior side that abuts the second radial is arcuate externally. The inferior angle of each is sunk in a deep pit, the central part of the plate is convex from which a radial ridge extends to each adjacent subradial, while the greatest prominence exists in the upper part.

Four of the second primary radials are hexagonal and one pentagonal, they are of unequal size and vary from a little wider than long to more than twice as wide as long. All of them are longitudinally convex in the central part and bear central nodes. The third primary radials are smaller than the second, of unequal size, pentagonal, axillary, and support upon each upper sloping side two small, short, secondary radials before reaching the free arms. The second and third primary radials together are not larger than the first. The radial ridge in each series continues across the secondary radials and unites with the convex outer surface of the arms. There are ten arm openings to the vault. There is a single small intersecondary plate, in each area, that is followed by a larger and longer plate, which separates the bases of the arms and unites with the plates of the vault.

The first interradials are the largest plates in the calyx, they are subpyramidal and terminate in an acute, central point. They broadly truncate the subradials, separate the primary radials, in in some areas, and, in others, both the primary and secondary radials, and are each followed by five or six plates, in the form of a yoke or arch, that reaches down half or more than half the length of the first interradial. They have, therefore, eight, nine or ten sides, depending on whether or not they abut the second primary radials, and whether there are five or six plates in the yoke. The three or four superior plates of this arch separate the secondary radials and are followed by three or four plates that separate the bases of the arms and unite with the plates of the vault. The number of plates in the regular interradial areas are, therefore, not quite uniform, and they graduate into the plates of the vault so as to leave no distinct line of separation.

In the azygous interradial area two plates truncate the subradial, one large, the other small. The large plate corresponds with the first plate, in the regular areas, and has only eight sides, one of which rests on a subradial, another against a first primary radial, another against a second primary radial, and the others against five plates, that form a yoke, as in the other areas, except one side of it reaches a subradial and separates the large plate entirely from one radial series. The area is wider than the regular areas and the plates are somewhat larger, but not more numerous. The superior plate in the yoke extends a little higher than the plates in the regular areas, it unites with plates, at the bases of the arms, and others that extend to the vault, as in the other areas, though not exactly in the same order of arrangement.

The vault is elevated over the arm furrows, convex on the azygous side of the proboscis, but somewhat flattened on the other side. The proboscis is subcentral. The vault is covered by numerous polygonal, highly convex plates and is moderately depressed toward the interradial areas. The proboscis is broken off, but so far as preserved, it is small, round and composed of small, highly convex plates.

This species is probably as nearly related to *Archæocrinu sculptus*, which we suppose was collected in the same group of rocks, as to any other, but the structural differences are so marked that no comparison is necessary.

Found in the Trenton Group, in Knox County, Tennessee, and now in the collection of Wm. F. E. Gurley.

ARCHÆOCRINUS PARVUS, n. sp.

Plate II. Fig. 26, basal view; Fig. 27, azygous side view; Fig. 28, summit view.

Species small; calyx saucer-shaped subpentagonal in outline, more than twice as wide as high; radial ridges not distinguished and interrupted at the sutures; plates sculptured; surface granular; columnar cavity of moderate depth and indicating by its shape a pentagonal column.

Basals sunk within the calyx and showing a pentagonal outline beyond the circumference of the column. Subradials longer than wide, sharply bent into the columnar cavity and upward between the radials, leaving a pentagonal cavity below bounded by a sharp, angular ridge, upon which the calyx may rest, showing the subradials in a side view.

First primary radials sculptured, wider than higher, pentagonal. Second radials twice as wide as high, hexagonal. Third radials short, pentagonal, axillary, and supporting upon each upper sloping side the secondary radials. No tertiary radials. Ten arm openings to the vault.

First regular interradial large, sculptured and supporting two plates in the second range that separate the secondary radials and unite with the plates of the vault. First azygous interradial large and supporting in the second range three plates, the lateral ones small; these are succeeded by three plates that unite with the plates of the vault, the lateral ones uniting with the protecting sides of the ambulacral furrows.

Vault moderately convex and covered with polygonal convex plates, proboscis small and subcentral.

This species, though small and somewhat resembling *A. asperatus*, is so distinct as to require no comparison to distinguish it.

Found in the Trenton Group, in Knox County, Tennessee, and now in the collection of Wm. F. E. Gurley.

FAMILY MITROCRINIDÆ, n. fam.

MITROCRINUS, n. gen.

[Ety *mitra* a turban; *krinon* lily.]

Calyx depressed; vault elevated. Basals three, equal. Primary radials three by six. Secondary radials. No subradials. Regular interradials three. Azygous interradials three or more, the first one resting on a single basal.

The peculiarities in this genus are the six radial series instead of five, and the resting of the first azygous plate on a single basal instead of on two basals. Beside this genus is from the Trenton Group and is the only one having three equal basals, thus far known, from the Trenton rocks of America. Type M. *Wetherbyi.*

This genus cannot be referred to any of the described families, if any regard is paid to the structure of the calices. The specimen is quite complete, on which the genus is established. It is symmetrical in all its parts, and a line drawn through the center of the azygous area will cut it in two equal parts, leaving three radial series upon each. The three basal plates are almost absolutely equal, notwithstanding one of them supports an azygous plate. The vault is as perfect as that of any other crinoid and has a resemblance to that of a *Dorycrinus.* Under the circumstances we propose the new family name *Mitrocrinidæ* and ascribe to it the following characters: Basals three. Primary radials three by six. No subradials. Regular interradials. Whether other characters ascribed to the genus will be found to be of family value will depend upon future discovery of allied genera.

MITROCRINUS WETHERBYI, n. sp.

Plate II, Fig. 4, azygous view, the central spine may be seen beyond the azygous opening and two of the subspinous plates on the sides, but the plates of the azygous side are small and sutures too obscure for correct illustration; Fig. 5, basal view, azygous side above; Fig. 6, Summit view.

Calyx depressed, radial elevations distinct, but not specialized as ridges; interradial areas concave; sutures slightly beveled; surface granular; height less than half that of the vault; arm openings directed horizontally.

Basals three, exposing externally a large heptagonal disc, the side on which the azygous plate rests being short and truncation slight. In the center there is a concave depression for the insertion of the head of the column which is surrounded by a pentagonal rim, too delicate for illustration, that indicates the column is pentagonal. First primary radials a little wider than long, superior face a little concave, three hexagonal and three heptagonal. Second radials more than twice as wide as long, hexagonal. Third radials twice as wide as long, pentagonal, axillary and bearing upon each superior sloping side secondary radials, giving to the species twelve arms.

There are three regular interradials in each area. The first hexagonal, longer than wide and succeeded by two plates in the second range, each of which is as large as the first one. These unite with the plates of the vault and those covering the ambulacral grooves. There is no boundary line between the plates of the calyx and vault as they graduate into each other in the interradial areas and the ambulacral coverings. First azygous plate pentagonal, rests on a single basal, and longer than wide; two plates in the second range which reach as high as the calyx proper and unite with the plates of the vault and ambulacral coverings. The azygous area is nearly perpendicular from the top of the first azygous plate to the summit of the vault, and, above the second range of plates, is covered by numerous smaller ones.

Vault ventricose, radial areas high. The larger plate occupies the summit and bears a short central spine or conical elevation. It is surrounded by eight plates, which are next in size, on the vault, all of which are convex and some of them somewhat conical. The other plates on the vault, including those on the radial and interradial areas, are polygonal, convex and granular. The azygous opening is separated from the central plate by three of the eight plates above described, as surrounding the central plate. It is broken, in our specimen, but does not appear to have extended higher than the central plate.

The specific name is in honor of Prof. A. G. Wetherby, to whose skill and untiring energy is due the discovery of this and the three preceding species as well as the locality from which they were obtained.

Found in the Trenton Group, in Knox county, Tennessee, and now in the collection of Wm. F. E. Gurley.

FAMILY POROCRINIDÆ, n. fam.

This family has five basals; five subradials; one by five radials; no regular interradials; small arms; and deep pits and pectinated rhombs, at the angles of the plates. It resembles, in its general structure, the *Cyathocrinidæ*, and *Poteriocrinidæ*, but the azygous area is not like that of any other known genus and the pectinated rhombs are like those belonging to *Cystideans*.

POROCRINUS KENTUCKIENSIS, n. sp.

Plate II, Fig. 10, side view showing deep pits or pectinated rhombs and part of the arms, azygous side on the right.

Calyx obpyramidal, pentagonal, in outline, with the angles at the center of the subradials and again at the arm bases. Height equal to the greatest diameter. Surface radiately sculptured from the center of each plate to the center of each adjoining one. The base of our specimen is slightly broken away so that the true length of the basal plates is not shown in the illustration. The subradials are the largest plates in the calyx and occupy more than one-third of the length. The first radials are next in size and a single, small, round arm, occupying about one-third the width, arises from the superior central part. Only three short plates in three of the arms are preserved in our specimen, but the ambulacral furrows may be seen extending to the central part of the vault. The third plate is not axillary and hence the arms do not bifurcate on that plate if at all. There are two azygous interradials that seem to be arranged as in the type of the genus, but our specimen is silicified and the sutures are very indistinct. The vault is quite convex in this species. There is a very large pectinated rhomb at each angle of every plate in the calyx and smaller ones on the vault. Twenty-eight can be distinguished in our specimen.

The general form, surface ornamentation and exceedingly large pectinated rhombs at once distinguish this species.

Found in the Trenton Group, in Mercer county, Kentucky, and now in the collection of Wm. F. E. Gurley.

FAMILY CYATHOCRINIDÆ.

CARABOCRINUS OVALIS, n. sp.

Plate II, Fig. 20, azygous side view; Fig. 21, opposite view.

Our specimens are silicified and part of the plates in the arms do not show the sutures. Calyx suboval in outline, the smaller end below, which is narrowly rounded, and the scar for the attachment of the column very small. Surface destroyed in silicification. Basal plates small. Subradials the largest plates in the calyx, wider than high and evenly rounded. The radials are the next in size, very evenly rounded and slightly truncated about one-third the width in the superior central part for the free arms. The arms are small and round and bifurcate on the second plate. They bifurcate again on the third or fourth plate, the silicification destroying the sutures. And one of the arms in every ray bifurcates again, making thirty arms in this species. The arms cluster together over the vault and are so interlaced that more divisions of the arms may take place which are not disclosed by either of the two specimens before us. The azygous plates are arranged as in *Carabocrinus radiatus*, but the first plate which truncates a basal plate is regularly hexagonal and about as wide as high, and thus differs in form from *C. radiatus*. The second plate is smaller and truncates a subradial. The third plate is fully as large as the first and longer than wide.

The general outline of the calyx in this species is much like *Carabocrinus vancortlandti*, but the arms are quite different, as the first bifurcation, in that species, takes place on the third plate, while in this one, it takes place on the second plate. The general form of the calyx is altogether different from that in *C. radiatus*, but the first bifurcation takes place on the second plate in the free arms, in both species, though above that the arms are altogether different.

Found in the Trenton Group, in Mercer County, Kentucky, and now in the collection of Wm. F. E. Gurley.

FAMILY POROCRINIDÆ, n. fam.

This family has five basals; five subradials; one by five radials; no regular interradials; small arms; and deep pits and pectinated rhombs, at the angles of the plates. It resembles, in its general structure, the *Cyathocrinidæ*, and *Poteriocrinidæ*, but the azygous area is not like that of any other known genus and the pectinated rhombs are like those belonging to *Cystideans*.

POROCRINUS KENTUCKIENSIS, n. sp.

Plate II, Fig. 10, side view showing deep pits or pectinated rhombs and part of the arms, azygous side on the right.

Calyx obpyramidal, pentagonal, in outline, with the angles at the center of the subradials and again at the arm bases. Height equal to the greatest diameter. Surface radiately sculptured from the center of each plate to the center of each adjoining one. The base of our specimen is slightly broken away so that the true length of the basal plates is not shown in the illustration. The subradials are the largest plates in the calyx and occupy more than one-third of the length. The first radials are next in size and a single, small, round arm, occupying about one-third the width, arises from the superior central part. Only three short plates in three of the arms are preserved in our specimen, but the ambulacral furrows may be seen extending to the central part of the vault. The third plate is not axillary and hence the arms do not bifurcate on that plate if at all. There are two azygous interradials that seem to be arranged as in the type of the genus, but our specimen is silicified and the sutures are very indistinct. The vault is quite convex in this species. There is a very large pectinated rhomb at each angle of every plate in the calyx and smaller ones on the vault. Twenty-eight can be distinguished in our specimen.

The general form, surface ornamentation and exceedingly large pectinated rhombs at once distinguish this species.

Found in the Trenton Group, in Mercer county, Kentucky, and now in the collection of Wm. F. E. Gurley.

FAMILY CYATHOCRINIDÆ.

CARABOCRINUS OVALIS, n. sp.

Plate II, Fig. 20, azygous side view; Fig. 21, opposite view.

Our specimens are silicified and part of the plates in the arms do not show the sutures. Calyx suboval in outline, the smaller end below, which is narrowly rounded, and the scar for the attachment of the column very small. Surface destroyed in silicification. Basal plates small. Subradials the largest plates in the calyx, wider than high and evenly rounded. The radials are the next in size, very evenly rounded and slightly truncated about one-third the width in the superior central part for the free arms. The arms are small and round and bifurcate on the second plate. They bifurcate again on the third or fourth plate, the silicification destroying the sutures. And one of the arms in every ray bifurcates again, making thirty arms in this species. The arms cluster together over the vault and are so interlaced that more divisions of the arms may take place which are not disclosed by either of the two specimens before us. The azygous plates are arranged as in *Carabocrinus radiatus*, but the first plate which truncates a basal plate is regularly hexagonal and about as wide as high, and thus differs in form from *C. radiatus*. The second plate is smaller and truncates a subradial. The third plate is fully as large as the first and longer than wide.

The general outline of the calyx in this species is much like *Carabocrinus vancortlandti*, but the arms are quite different, as the first bifurcation, in that species, takes place on the third plate, while in this one, it takes place on the second plate. The general form of the calyx is altogether different from that in *C. radiatus*, but the first bifurcation takes place on the second plate in the free arms, in both species, though above that the arms are altogether different.

Found in the Trenton Group, in Mercer County, Kentucky, and now in the collection of Wm. F. E. Gurley.

FAMILY GAUROCRINIDÆ.

RETIOCRINUS ALVEOLATUS, n. sp.

Plate II, Fig. 22, azygous view.

Column comparatively large and pentagonal. Calyx pentagonal, transversly. Basals extend but little beyond the column, deeply sunken or bearing a pit at each lower lateral side and a convex ridge directed to each adjacent subradial. Subradials longer than wide, the superior angle reaching almost as high as the first radials, and bearing four radiating rounded ridges, two of which unite with the basals below, and the others with the adjacent first radials. There is a large deep pit at each lateral angle. These pits in the calyx look like the pits or pectinated rhombs in *Porocrinus*. Our specimen is silicified, and the depth of these pits or whether or not they pass to the inside of the calyx cannot be accurately determined. The subradial on the azygous side bears an additional ridge that extends upward to the large plates in the middle of the azygous area.

There are four primary radials in each series, rounded externally and, at first view, looking like free arms, but there are small plates upon each side of the ambulacral furrow that unite with a central balloon-shaped body exposing the small plates in the interradial areas. There are four secondary radials in each series and they are connected, internally, with the central part of the body just as the primary radials are. The arms then appear to become free and each one bifurcates again from the fourth to the ninth plate, as near as the plates can be counted in our specimen. Thus giving to the species forty arms. In the azygous area there is a central row of large plates, looking like an arm, that extends as high as the secondary radials, and is connected with the central balloon-shaped body just as the primary and secondary radials are, except, of course, there is no ambulacral furrow, but a furrow nevertheless. The appearance of our specimen indicates the continuance of the balloon-shaped body, in the form of a proboscis, probably to the height of the arms, but there may be some doubt about it, as the arms are so numerous and so closely crowded together, that it cannot be clearly distinguished.

Billings described the genus *Retiocrinus* as follows: "This remarkable genus has no perfectly formed plates. The cup consists of a reticulated skeleton, composed of rudimentary plates, each consisting of a central nucleus, from which radiate from three to five stout processes. Of such plates there are five in the basal series, five in the subradial, and five in the radial series. On the azygous side the subradial has five processes; the others have four each."

The general appearance of the genus is that of a reticulated skeleton, as Billings described it, but the plates are all perfectly formed and not by any means rudimentary. The interradial areas are abruptly sunken, and, as shown in our specimen, small plates connect the inner sides of the radials, with a central body, that is also covered with very small plates, which, if not so deeply depressed, would look somewhat like the interradial areas in *Gaurocrinus*, and if they were not depressed, at all, they would look like the interradial areas of *Glyptocrinus*, except they are covered with smaller plates. The ambulacral furrows in *Glyptocrinus* and *Gaurocrinus* enter the top of the calyx and unite centrally immediately below the vault, while in this genus they appear to follow down the radial series and to unite, at the lower part of the calyx, or between the subradials. The structure indicates this, but the channels forming the union have not been discovered. We have called this central cavity a balloon-shaped body, only for the purposes of description, for it is the same as the cavity of the calyx in other genera. Its form is only more balloon-shaped than an ordinary calyx because it is small in the lower half of the calyx. Even if the ambulacral furrows unite at the summit of the calyx, and not below, as we have thought most probable, the other structural parts are sufficient to warrant the generic name. No comparison of this species with any other is necessary to distinguish it, but it is interesting to note the finding of a new species in this rare genus, several hundred miles distant from the typical locality.

Found in the Trenton Group, in Mercer County, Kentucky, and now in the collection of Wm. F. E. Gurley.

FAMILY GLYPTOCRINIDÆ.

GLYPTOCRINUS MERCERENSIS, n. sp.

Plate II, Fig. 23, azygous side view.

General form of the calyx, somewhat obpyramidal, transverse section pentagonal. Radial ridges prominent, plates deeply sculptured with stellate ornamentation. Interradial areas flattened. Column round and medium size.

There are five sculptured basal plates that extend in the form of a sharp ring below the top of the column. They are a little wider than high. The first primary radials are heptagonal, rather wider than high. The second primary radials are hexagonal, longer than wide and about two-thirds as large as the first. The third primary radials are heptagonal, abut upon two interradials, at each side, wider than high, about two-thirds as large as the second, axillary, and bear upon the superior sloping sides the secondary radials. There are three or four secondary radials in each series that enter into and form part of the calyx and then the radial ridge becomes more prominent and the arms become free. There are no tertiary radials and no divisions of the arms. There are, therefore, only ten arms in this species. The plates of the arms are short and the pinnules very dense.

The regular interradial areas have one large plate in each, resting upon the upper sloping sides of the first primary radials and separating the second primary radials. It is followed by two plates in the second range and above this the number cannot be ascertained from our specimens. In the azygous interradial area there is one large plate resting upon two first primary radials, which is followed by three plates in the second range, and above these the number of plates can not be determined in our specimens. A ridge arises at the center of the first azygous plate and extends straight up the center of the azygous area, a distance beyond the commencement of the free arms, and to the top of a proboscis. This species possesses a vault altogether different from that belonging to *G. decadactylus*, and it also possesses a proboscis or extension of the vault which has not been heretofore known to belong to any species of *Glyptocrinus*. In the region of the first and second radials and first interradials, it resembles *G. decadactylus*, but is quite different in all other parts, beside having only ten arms. It can not be mistaken for any other described species.

Found in the Trenton Group, in Mercer county, Kentucky, and now in the collection of Wm. F. E. Gurley.

FAMILY CALCEOCRINIDÆ.

CALCEOCRINUS KENTUCKIENSIS, n. sp.

Plate II, Fig. 24, anterior side view; Fig. 25, posterior side, showing place of attachment of the column of same specimen.

From the cicatrix for the attachment of the column, we infer, that the body hung close to the column; the column is small and round. We have two specimens, about equally well preserved, both are silicified, but show the sutures correctly, unless it may be in the basal plate. The basal plate is triangular and, as shown by the sutures, composed of four anchylosed plates, though the sutures are obscure. The columnar facet is at the posterior angle. There is a wide gaping suture between the basals and the radials on the anterior side, that is somewhat denticulated on the anterior margin. Following this gaping suture on the anterior side there are three radials, in the first transverse series; the middle one is twice as long as wide, quadrangular, and constricted in the middle; the outer ones are hexagonal, about twice as wide and about twice as large as the middle one. The second transverse series commences in the middle part with a short wide plate that rests upon the superior side of the middle plate in the first series, and upon the inner sloping sides of the two lateral plates, in the first series. It is about three times as wide as long and is succeeded by a plate, that contracts rapidly upward, somewhat in the form of the frustum of a cone. It has a length about equal to the shorter width. This last plate bears a free single arm composed of rather long round joints. The superior lateral side of each of the lateral plates in the first series bears two brachial plates, the second one of which is axillary and bears free arms. Every second or third plate in the free arms is axillary, though one of the rays thrown off from each axillary plate is smaller than the main arm and does not bifurcate again.

Turning now to the posterior side, we find on the right a small intercalated triangular plate, and a brachial series of three plates resting upon the right side of the triangular basal and this intercalated triangular plate. This brachial series reaches about as high as the other brachial series, the last plate is axillary and bears free arms. Every second or third plate in these free arms is axillary, though one of the rays thrown off from each axillary plate is smaller than the main arm and does not bifurcate again. On the left of the posterior side we also find a small intercalated triangular plate, and a longitudinal azygous series resting on the left side of the triangular basal and this intercalated triangular plate. The azygous series consists of three large round plates, having a width more than twice as great as their length, and they are followed by a long round proboscis that extends beyond the limit of our broken specimens and probably beyond the length of the arms. The three azygous plates reach about as high as the brachials above described and in comparing with other crinoids this would be the limit of the calyx, and above this are the free arms and long proboscis. It will be understood that we have described this species as if it were standing up instead of hanging down from the end of the column.

It is unnecessary to compare this species with any others that have been described, though it is doubtless congeneric with the species described by W. R. Billings, and for which Ringueberg has described a genus under the name of *Castocrinus*. Probably, without hesitation it should be called *Castocrinus kentuckiensis*. But there has been so much blundering and bad work done with the *Calceocrinidae* and so many synonyms proposed, that we have thought, without taking the time now to review the subject, it would be sufficient to provisionally refer it to *Calceocrinus*, though we think, at present, that *Castocrinus* will be retained for this generic division of the family.

Found in the Trenton Group, in Mercer county, Kentucky, and now in the collection of Wm. F. E. Gurley.

FAMILY POTERIOCRINIDÆ.

POTERIOCRINUS CIRCUMTEXTUS, n. sp.

Plate II, Fig. 29, azygous side, showing the interlacing arms and proboscis; Fig. 30, opposite side of same specimen.

Species medium size, with a remarkably large proboscus. Calyx cup-like, or somewhat obconoidal; truncated below for a moderately large column; wider than high; sutures distinct; surface smooth or very finely granular.

Basals one-fourth wider than high, pentagonal, gradually expanding. Subradials about as long as wide, three hexagonal and two heptagonal; those adjoining the azygous area are heptagonal.

First radials of unequal size, but about twice as wide as high, protuberant and rounded to the first brachials; hexagonal; the articulating scars occupy rather more than half the diameter of the plates and are directed outward and upward at an angle of about seventy degrees; a slightly gaping suture separates the first radials from the first brachials, and the superior faces of the first radials unite with the small plates that cover the vault.

There are four brachials in each of the latteral rays and three in each of the other three rays; they are short, rounded, and the last one supports upon each of its upper sloping sides free arms. All of the arms again bifurcate on the fourth plate, except one, and it bifurcates on the fifth plate. Every arm bifurcates again on plates ranging from the sixth to the sixteenth. At this height there are forty arms; some of them are seen to bifurcate again in our specimen, and probably all bifurcate again, making eighty arms in the species. The arms are round, plates long and sutures transverse.

The azygous area is wide and ventricose. The first plate is pentagonal, rests between the upper sloping sides of two subradials, separates the first radial on the right from the second azygous plate, and is truncated above for the third plate. The second plate is hexagonal, rather larger than the first, truncates a subradial, abuts the first radial on the left and the first and third plates on the right and supports two plates above. The third plate rests upon the first and is in line with the upper half of the second, supports two plates above and other plates on the right. The first and third plates thus described support three plates in the next range, which are succeeded by plates of the proboscis.

The proboscis is large, long, cylindrical, and covered with polygonal plates. Round pores penetrate the proboscis throughout its length at nearly every angle of the plates, and, frequently, on the sutures between the angles. The vault is covered with small plates.

This species is more nearly related to *P. subramosus* than to any other which has been described, but it is distinguished from that species by the relative proportion of the plates in the calyx, by the number and position of the azygous plates, and by the great difference in the arms, and no doubt, also, in the character of the proboscis, which is unknown in that species.

Found in the Keokuk Group, at Crawfordsville, Indiana, and now in the collection of Wm. F. E. Gurley.

ZEACRINUS GRANDICULUS, n. sp.

Plate II, Fig. 31, azygous view; Fig. 32, view opposite the azygous area.

Body rather large, robust and elongate-ovate in outline. Calyx very low. Columnar cavity shallow. Surface smooth or finely granular. Column very small, round and composed of thin plates.

Basal plates within the calyx. Subradials with an acute superior angle, but invisible in a lateral view. First radials about one-half wider than long, rapidly expanding to the superior lateral angles, and truncated the entire width above for the support of the second primary radials. The inferior angles do not extend into the columnar cavity. Four of them are pentagonal, but two of them are separated by the extension of an azygous plate so as to reach the point of a subradial, and the one on the right supports two azygous interradials, as well as the radial series which gives to it an heptagonal outline. Four of the second primary radials are pentagonal, one-half wider than high, axillary, and support on each upper sloping side the secondary radials; but in the ray opposite the azygous area there are three primary radials, and consequently the second is quadrangular, twice as wide as high, and supports the third, which is three times as wide as high, pentagonal, axillary, and supports upon the upper sloping sides the secondary radials.

In one of the secondary radial series there are three plates, in six of them each has four plates, in two of them each has six plates, and one of them has five plates. One ray which is opposite the azygous area, having six secondary radials, supports upon each upper sloping side tertiary radials, which continue to the end of the arms. Nine other tertiary radial series do not bifurcate, but so far as can be determined all the others bifurcate once, and one of the arms thus thrown off in each series bifurcates again, except in one ray. This gives us eight arms in each of four series, but only five arms in the ray opposite the azygous side, which possesses three primary radials, thus making thirty-seven arms in this species. But there is some injury to the specimen in two or three places, and the last bifurcation may not take place in one or two rays, and possibly, therefore, the species may have only thirty-six arms.

The azygous area commences with one plate, sending a sharp angle between the first radials to the angle of a subradial; this is succeeded by three plates in the second range, and these by three plates, and these again by two, the superior plate being the largest in the area and acutely pointed above. There are, therefore, nine azygous plates.

Found in the Kaskaskia Group, at Bowling Green, Kentucky, and now in the collection of Wm. F. E. Gurley.

POTERIOCRINUS SCOPAE, Miller & Gurley.

Plate III, Fig. 1, lateral view magnified two diameters; Fig. 2, lateral view of same specimen natural size, azygous area on the left.

When the authors described this species in 1890 in their "Description of some new genera and species of Echinodermata from the Coal Measures and Subcarboniferous Rocks of Indiana, Missouri and Iowa," which work was subsequently reprinted in the 17th Report of the Geological Survey of Indiana, only the azygous side was illustrated, and, as it seemed desirable to have it further illustrated, two lateral views are here presented, one natural size and one magnified two diameters.

The specimen is from the typical locality, in the Kinderhook Group, at Le Grand, Iowa, and is in the collection of Wm. F. E. Gurley.

POTERIOCRINUS MACCABEI, n. sp.

Plate III, Fig. 3, posterior side, natural size; Fig. 4, same magnified two diameters; Fig. 5, azygous side of same specimen magnified two diameters, part of the azygous area broken away, there is on this specimen a Poteriocrinus decrepitus showing the posterior side somewhat injured; Fig, 6, same, natural size.

Species small, but bearing very long rugged or geniculated arms. Calyx obconoidal, as seen from the posterior side, but quite unsymmetrical on account of the development of the azygous area; height and greater diameter nearly equal; plates smooth. Column small, round.

Basals moderate size, in proportion to the calyx, with superior angles acute. Subradials a little wider than high, except one on the azygous side which has a length fully equal to the greater width; four of them are hexagonal, the other two are heptagonal. The azygous subradial, which is truncated at the top, is heptagonal and the largest plate in the calyx. The other heptagonal plate is on the right of the azygous area and is a little larger than either of the hexagonal plates. First radials one-third wider than high, quite convex longitudinally, which leaves the separating sutures much depressed, pentagonal and truncated the entire width above, where the sutures are slightly gaping. A single, long, rounded, brachial, supports upon the upper sloping sides, in each radial series, the free arms. These brachials are contracted in the middle part and of unequal length; the one opposite the azygous area is the longer, the two adjacent are the shorter, and the other two have an intermediate length. There are only ten arms in this species; they are long and composed of rather long, cuneiform, alternately projecting plates. Each projecting joint bears a large, tapering, long jointed pinnule, which gives to the arms a very rough or crisped aspect.

The azygous area is wide and covered with a double series of alternate plates. The first plate is pentagonal, longer than wide and rests between the superior sloping sides of two subradials and between the first radial on the right and the second azygous plate on the left and is truncated on top for the third azygous plate;

the second plate is hexagonal, larger than the first, rests upon the truncated upper end of the largest subradial and between the first radial and a summit plate on the left, and the first and third azygous plates on the right and is truncated at the upper end for the fourth plate. This alternate arrangement continues as far as the proboscis is preserved in our specimen.

This species is peculiar in its comparatively long, rough arms and wide azygous area. It need not be compared with any other described species, for *P. legrandensis* is as near to it as any other, and in that species there are twenty much shorter arms and a narrower and different azygous area.

Found in the Kinderhook Group, at Le Grand, Iowa, and now in the collection of Wm. F. E. Gurley.

It was found by John McCabe, of Quarry, Iowa, in whose honor we take pleasure in dedicating this beautiful crinoid.

POTERIOCRINUS HAMMONDI, n. sp.

Plate III, Fig. 7, azygous view, magnified two diameters; Fig. 8, same, natural size.

Species small, but bearing long slender arms, which, when closed around the proboscis as in our specimen, make the body subcylindrical. Calyx obconoidal; height and greater diameter nearly equal; plates smooth. Column rather large at the calyx, but tapering for a short distance, when it becomes of ordinary size and consists of thin, round plates.

Basals of moderate size, in proportion to the calyx, with superior angles acute. Subradials hexagonal, wider than high, the one below the azygous area is much the wider, but so broadly truncated on top as to give it little if any greater length. First radials about as high as wide, evenly rounded, pentagonal, and truncated the entire width above, where the sutures are distinct but not gaping. A single, very long, contracted and rounded brachial, supports upon the upper sloping sides, in each radial series, the free arms. The contraction of these remarkably long brachials actually constricts the body immediately above the calyx. One of the lateral brachials is shown in our specimen, and it is a little shorter than either one adjoining the azygous side of the proboscis, and we may presume the one opposite the azygous area is the longer one, as that is the case in *Poteriocrinus maccabei* and in some other species. There are only ten arms in this species;

they are long and composed of long, slightly cuneiform, alternately projecting plates. Each projecting joint bears a small pinnule, which does not prevent the arms from closing tightly around the proboscis.

The azygous area is not large in this species. There is only one plate within the calyx, and it broadly truncates a subradial and separates two first radials. There appear to be two plates succeeding this one, but the arms in our specimen prevent further examination of the plates.

This species is peculiar in its long, delicate form, closed arms, long brachials and constriction above the calyx. The azygous area is also peculiar and we know of no species with which it is necessary to make any comparison in these particulars.

Found in the Kinderhook Group, at LeGrand, Iowa, and now in the collection of Wm. F. E. Gurley. The specific name is given in honor of Mr. L. A. Hammond, an enthusiastic collector of LeGrand, Iowa.

POTERIOCRINUS MACCABEI *var.* DECREPITUS, n. sp.

Plate III, Fig, 9, azygous side of a depressed and somewhat injured specimen magnified two diameters; Fig. 11, same, naturel size; Fig. 10, posterior view two diameters; Fig. 12, same, natural size; the posterior view of another specimen, magnified and natural size, may be seen on Poteriocrinvs maccabei in Figs. 5 and 6.

This is a small species bearing short rugged arms. Calyx obconoidal as seen from the posterior side, but unsymmetrical on account of the development of the azygous area. Diameter one half more than the height; plates smooth; column small, round.

Basals small and superior angles somewhat obtuse. Subradials one-half wider than high, except the one on the azygous side, which has a length about equal to the greatest width; four of them are hexagonal, the other two are heptagonal. The azygous subradial, which is truncated at the top, is heptagonal and the largest plate in the calyx. The other heptagonal plate is on the right of the azygous area, but is not larger than the hexagonal plates. First radials, one-third wider than high, quite convex longitudinally, which leaves the separating sutures much depressed pentagonal, and truncated the entire width above, where the sutures are gaping. A single, rounded brachial supports upon the upper sloping sides in each radial series, the free arms. These brachials are contracted in the middle part and of unequal length; the one opposite the azygous area is the longer, the two adjacent are the shorter and the other two have an intermediate length. There are only ten arms in this species; they are short though composed of rather long, cuneiform, alternately projecting plates. Each projecting joint bears a large, tapering, long jointed pinnule, which gives to the arms a rough geniculated aspect.

The azygous area is covered with the same number of plates which are arranged in the same order that they occur in *P. maccabei*. The difference between the two is that in this species the area is proportionally narrower.

We have three specimens of this species which are free (and accidentally the best one is not illustrated) beside the one figured on *P. maccabei*, and they all bear the same proportions as to size of calyx and arms and size of the plates. The calyx in this species is fully as large as it is in *P. maccabei*, though slightly differing in form, the arms and pinnules are as coarse, but the arms have not more than two-thirds the length. The question then arises whether the minor differences which may be seen in the illustrations and the discriptions, coupled with the wider azygous area and longer arms in *P. maccabei*, are sufficient to distinguish species. One cannot be the young of the other unless age widened the azygous area and lengthened the arms without increasing the size of the plates, which is contrary to what we know of these animals. *P. maccabei* is graceful in its form and is not abnormal. Possibly the difference between the two should be regarded as of specific value, but we have not regarded it as of more than varietal importance.

Found in the Kinderhook Group, at LeGrand, Iowa, and now in the collection of Wm. F. E. Gurley.

ZEACRINUS SALEMENSIS, n. sp.

Plate III, Fig. 17, lateral view, azygous area on the left.

Our specimen is on a slab and the ray opposite the azygous area is not exposed. The species is of medium size. Calyx basin-shaped below the summit of the first radials and subpentagonal in outline in the superior part, deeply concave below; sutures distinct, surface granular.

Basals form a narrow pentagonal rim almost obscured by the column. Subradials abruptly bent upward and into the basal concavity, at about the middle part, about as wide as long. The one on the right of the azygous area heptagonal and broadly truncated for the first radial, the next one to the right hexagonal. First radials twice or more than twice as wide as high, pentagonal, truncated the entire width above and separated from the second radials by a gaping suture. Second radials larger than the first, about twice as wide as high, pentagonal, prominent almost nodose at the superior angle, and supporting on each upper sloping side the secondary radials. There are six secondary radials in each arm shown by our specimen, four of them are short plates with transverse sutures, the first one is the larger one and the last is pentagonal and supports upon each of the upper sloping sides the tertiary radials. One of the arms does not again bifurcate and consists of short flattened quadrangular plates. The other arm bifurcates again on the eighth plate and the arm adjoining the azygous side again bifurcates, and so does the corresponding arm in the other ray, which gives us seven arms to each of these rays.

The first azygous plate is pentagonal, abuts upon two subradials and the first radial on the right, and supports two interradials in the second range, one of which truncates a subradial. There are two interradials in the third range, beyond which they are not shown in our specimen.

It is not necessary to compare this species with any other for the purpose of distinguishing it.

Found in the Keokuk Group, at Salem, Indiana, and now in the collection of Wm. F. E. Gurley.

ZEACRINUS CYLINDRICUS, n. sp.

Plate III, Fig. 19, a large specimen compressed antero-posteriorly showing azygous side; Fig. 20, a smaller specimen compressed laterally showing azygous side; Fig. 21, opposite view of same.

This species is rather large and very long. The body is subcylindrical, though constricted above the calyx, slightly fusiform in the middle part, and slowly tapering above.

Calyx low, basin-shaped below the summit of the first radials, moderately concave below; plates convex; sutures distinct; surface granular. Column round and pierced by a very small, round central columnar canal.

Basals form a narrow pentagonal rim around the column about one-half wider than the diameter of the column. Subradials longer than wide, and curve into the basal concavity and upward, at about the middle part, so as to be visible in a side view. The curve into the basal concavity is abrupt and the middle part of each is depressed before uniting with the basal plates. Four are hexagonal and two heptagonal. First radials about one and a half times as wide as high, pentagonal, truncated the entire width above, and separated from the second radials by a gaping suture. Second radials smaller than the first, about twice as wide as high, pentagonal, and support upon each upper sloping side the secondary radials or free arms. There are, therefore, ten arms in this species. The arms are very long, subfusi form, and composed of a single series of short, quadrangular or slightly cuneiform plates. The pinnules are composed of subcylindrical pieces having a length equal to three diameters.

The first azygous plate is rather large, convex, pentagonal, rests between two subradials and the first radial on the right and abuts upon the second and third interradials. The second interradial truncates a subradial, is nearly as large as the first, and the succeeding plates are much smaller and alternately arranged as in other species of this genus.

This species has been confounded with *Z. maniformis*, by some collectors, but in that species the basal plates are hidden by the column, the body is shorter, and there are only nine arms, as the radial series opposite the azygous area bears only a single arm. It is still farther removed from all other species.

Found in the Kaskaskia Group, in Pulaski county, Kentucky, and now in the collection of Wm. F. E. Gurley.

FAMILY PLATYCRINIDÆ.

PLATYCRINUS CORTINA, n. sp.

Plate III, Fig. 15, lateral view of calyx; Fig. 16, summit view with part of the vault, plates, grooves and pores preserved.

Species medium or rather below medium size. Calyx goblet-shaped; about as high as wide; broadly truncated below; round and slightly contracted immediately above the base, highly convex and protruberant in the region of the arm-bases, so as to give it a marked pentagonal outline when seen from above. Plates thick. Sutures distinct. Surface papillose or very coarsely granular. Column small, round and attached to the base in a radiately lined hemispherical depression. Columnar canal very small and round.

Basals form a low, round cup, with a slightly expanded sharp rim at the base. First radials about as long as wide, expanding very little above the basals, longitudinally convex, and becoming very protruberant at the articulating facets for the second radials. Articulating facets for the second radials a little more than half the width of the plates and directed outward and upward at an angle of about seventy degrees. Second radials short, axillary and notched for the ambulacral furrows.

The vault, so far as preserved in our specimen, is only slightly convex. The first radials, between the arm bases, curve slightly toward the vault. There are three plates between the arm furrows, the lateral ones form part of the ambulacral covering and the middle one is an interradial proper. There is a pit or pore at the junction of each interradial with the two first radials at the dividing suture, and there is also a pit or pore on each side of the ambulacral furrows, at the suture lines of the first radials. Whether or not any or all of these are ovarian apertures we are unable to state. The ambulacral furrows are shown in our specimen as open gutters and we suppose they were covered with small plates, such as cover arm furrows, which have not been preserved. From some fragments that occur on our specimen, that are not shown in the illustration, we are led to believe that the vault has a central orifice on the summit, possibly covered with small plates, in the same way we have supposed the ambulacral grooves to have been covered.

The external appearance of the calyx of this species somewhat resembles *P. allophylus* and *P. brittis*, but the differences are sufficient to at once distinguish it, if attention is paid to the form and to the articulating facets on the first radials. The differences are so great that no descriptive comparisons will serve any one in distinguishing them. But the vault, in this species, is wholly different from either of the above mentioned species and from that of any other known *Platycrinus.* If generic distinctions can be founded upon the vault, then this species does not properly belong to *Platycrinus* or to any other described genus. But, as we have only a fragment of the vault, we would not be justified in founding a genus upon it. We are convinced, that it properly belongs to the family *Platycrinidæ* and is nearer, in structure, to *Platycrinus* than to any other described genus, and hence, provisionally, refer it to that genus.

Found by the veteran collector and learned geologist, R. A. Blair, of Sedalia, Missouri, in the Choteau limestone of that locality, and now in the collection of S. A. Miller.

BARYCRINUS EXPANSUS, n. sp.

Plate IV, Fig. 2, view of the calyx, azygous side below.

Species very large, robust. Calyx more than twice as wide as high; plates very thick, highly convex; sutures distinct, sunken at the angles. Column large, pentagonal.

Basal plates comparatively small, less than one-fourth as large as the subradials, wider than high, and forming a very shallow, pentagonal, saucer-shaped cup. Subradials four or five times as large as the basals, a little wider than long, nearly equal in size, four hexagonal and one, on the azygous side, which is very broadly truncated for the azygous plate, heptagonal. First radials larger than the subradials, about three times as wide as high, nearly equal in size, remarkably thick, and truncated a little more than half the width for the reception of the second radials. The ambulacral notch very small, and facet for the second radials nearly perpendicular or having an inclination of not more than ten degrees. Azygous plate quadrangular, wider than high and a little more than half as large as a subradial.

are twelve plates, in some of the arms, on our specimen, and if complete there would probably be as many more.

This species cannot be confounded, with any other, from rocks of the same age, nor, indeed, with any hitherto described.

Found in the Keokuk or Warsaw Group, in Clark county, Indiana, and now in the collection of Wm. F. E. Gurley.

ICHTHYOCRINUS SPINOSULUS, n. sp.

Plate V, Fig. 4, view of a compressed specimen, with part of the spines on the first radials broken off.

Our specimen is compressed, but the true form with the arms folded is roughly ovoid. Distinct sutures separate the plates. All axillary plates bear a central spine and there are occasional spines on other plates. The entire surface is papillose or very strongly granular. The column is large, round, tapers rapidly from the body and is composed of thin plates. The basals and subradials are entirely covered by the head of the column and have not, therefore, been observed. There are no interradials.

Primary radials, three in each series; they gradually widen, but are not of exactly the same length and hence there is a slight interlocking of plates, instead of straight sutures separating the different series. The first primary radials are rather longer than either of the others and each bears a remarkably strong spine, that is directed downward, by the side of the column. The second primary radials are arcuate in the middle of the upper face for the projection of a lip or flange from the third plates and each bears three small spines, one central and one on each side. The third primary radials have steep superior sloping sides, each bears a strong central knob or short spine, and two small spines, one on each side. They are axillary and bear on each upper sloping side three secondary radials.

The first and second secondary radials are of about the same size, arcuate, and are produced transversely in a sharply convex central ridge with three obscure nodes on each. The third secondary radials are larger and longer and each bears a very strong central node or obtuse spine, and supports upon each upper sloping side a single arm or tertiary series. There are, therefore, twenty arms in this species. Each arm is composed of a single series of plates united by arcuate instead of transverse sutures. The arms are infolded and broken at the superior end of our does not appear to be pressed out of shape, the arms are pressed together a little, so as to make them thinner, laterally, than they should be. The plates preserved in our specimen are longer than wide. The first azygous plate is more than twice as long as wide, rests in a notch between two first radials, truncating the one on the right more than the one on the left, and extends nearly to the top of the second radials. It is followed by two plates, the larger one extending down, on one side, one third the length of the plate, and the smaller one truncating the upper side. These two plates are followed by a triangular plate that reaches nearly to the top of the third radials.

The peculiar, flattened calyx, subpyramidal, angular and beveled plates and arrangement of the azygous plates distinguish this from all other described species.

Found in the Keokuk Group, at Button Mould Knob, Kentucky, and now in the collection of Wm. F. E. Gurley.

FAMILY ICHTHYOCRINIDÆ.

ICHTHYOCRINUS CLARKENSIS, n. sp.

Plate IV, Fig. 5, lateral view of a compressed specimen.

Species small. Our specimen is compressed, but the general form with the arms folded is subovate. The plates are free from spines and nodes; the sutures are very distinct and slightly arcuate, the superior plates generally overlap the inferior ones in the middle part. The column is very large and entirely covers the basals and subradials so they have not been observed. There are no interradials.

There are three primary radials in each series. They widen rapidly and are subequal in length. The different series interlock instead of having a straight separating suture. There are four secondary radials in each series of about the same length, and each plate has about the same length as a primary radial, they expand very little, so that the fourth or axillary plate is not much wider than the first plate. The different series interlock in the same manner that the primary series do. The fourth plate supports upon each upper sloping side a single non-bifurcating arm, which gives to the species twenty arms. The arms are composed of short quadrangular plates, with arcuate sutures. There are twelve plates, in some of the arms, on our specimen, and if complete there would probably be as many more.

This species cannot be confounded, with any other, from rocks of the same age, nor, indeed, with any hitherto described.

Found in the Keokuk or Warsaw Group, in Clark county, Indiana, and now in the collection of Wm. F. E. Gurley.

ICHTHYOCRINUS SPINOSULUS, n. sp.

Plate V, Fig. 4, view of a compressed specimen, with part of the spines on the first radials broken off.

Our specimen is compressed, but the true form with the arms folded is roughly ovoid. Distinct sutures separate the plates. All axillary plates bear a central spine and there are occasional spines on other plates. The entire surface is papillose or very strongly granular. The column is large, round, tapers rapidly from the body and is composed of thin plates. The basals and subradials are entirely covered by the head of the column and have not, therefore, been observed. There are no interradials.

Primary radials, three in each series; they gradually widen, but are not of exactly the same length and hence there is a slight interlocking of plates, instead of straight sutures separating the different series. The first primary radials are rather longer than either of the others and each bears a remarkably strong spine, that is directed downward, by the side of the column. The second primary radials are arcuate in the middle of the upper face for the projection of a lip or flange from the third plates and each bears three small spines, one central and one on each side. The third primary radials have steep superior sloping sides, each bears a strong central knob or short spine, and two small spines, one on each side. They are axillary and bear on each upper sloping side three secondary radials.

The first and second secondary radials are of about the same size, arcuate, and are produced transversely in a sharply convex central ridge with three obscure nodes on each. The third secondary radials are larger and longer and each bears a very strong central node or obtuse spine, and supports upon each upper sloping side a single arm or tertiary series. There are, therefore, twenty arms in this species. Each arm is composed of a single series of plates united by arcuate instead of transverse sutures. The arms are infolded and broken at the superior end of our specimen, but as many as thirty plates may be counted in a single arm. Some of the arm plates bear a central spine or node, but there is not uniformity in the different arms in this respect.

This species is remarkable for its spines, nodes, and rough, uneven, external surface, and is distinguished, by its structure and the number of plates in the primary and secondary series, from all other species.

It was found in Clark county, Indiana, in what is called the Knobstone, but which we think must be of the age of the Keokuk Group, and is now in the collection of Wm. F. E. Gurley.

FAMILY DOLATOCRINIDÆ.

DOLATOCRINUS AMPLUS, n. sp.

Plate IV, Fig. 6, basal view; Fig. 7, side view; Fig. 8, summit view.

Calyx large, subcylindrical or bowl-shaped, concave below. All the plates are ventricose or subspinous and radiately furrowed toward the margins. Our specimen is injured at the point of the columnar attachment and part of the radial plates are destroyed.

Basal plates not observed. First primary radials probably as wide or wider than long. Second primary radials quadrangular, a little wider than long. The calyx will rest on these plates and the first interradials. Third primary radials larger than the second, wider than high, pentagonal and bear upon each upper slopiing side a single secondary radial. The secondary radials are axillary and bear upon each upper sloping side four or five tertiary radials. There are, therefore, four arms in each series or twenty arm openings to the vault.

The first interradials are the largest plates in the calyx. Four of them have nine sides each, while the azygous plate has eleven sides. In the regular areas the first plate separates the primary and secondary radials and is broadly truncated on top for a second plate that separates the secondary and first tertiary radials and is slightly truncated on top by a small plate in the third range, and this is followed by two small plates in the fourth range which connect with small plates that separate the arms and unite with the plates of the vault. The difference between the azygous area and the other areas is very slight and consists in the fact, that the first plate abuts against the first tertiary radials and that the second plate is followed by two plates in the third range instead of one.

The vault is convex, slightly depressed in the interradial areas and apparently bears a subcentral proboscis. The plates are anchylosed in our specimen, and show none of the sutures, and, possibly the hole, which we suppose indicates a proboscis, may be only a hole broken into the vault. There are two orifices between each of the arms that penetrate the vault horizontally. They appear to be excurrent and are of the same character as those in *D. grandis, D. lacus, D. marshi, D. stellifer and D. approximatus.*

This species is so distinct from all others that have been described, that no comparison with any of them is necessary.

Found in the Hamilton Group, near Charlestown, Indiana, and now in the collection of Wm. F. E. Gurley.

FAMILY ACTINOCRINIDÆ.

ACTINOCRINUS MONTICULIFERUS, n. sp.

Plate IV, Fig. 1, view of calyx azygous side on the right.

This is a remarkably large and robust species, the plates are thick and each one bears a more or less ventricose central node, and the larger plates are radiately sculptured toward the margins. The interradial areas are depressed, giving to the calyx a pentagonal outline.

Basals truncated below so as to have a diameter at the base, equal to about twice the height, they stand upright and are strongly beveled toward the lateral sutures. The middle part of the base has a hemispherical depression for the insertion of the column, leaving a wide flattened rim around the head of the column. First primary radials much smaller than the basals, longer than wide, three hexagonal and two heptagonal. Second primary radials wider than high, hexagonal and less than half as large as the first. Third primary radials in some of the rays hexagonal, larger than the second, wider than high and support on the superior sloping sides the secondary radials. There is a single secondary radial in each series, somewhat smaller than the third primary, wider than high, some heptagonal and others hexagonal, and each supports upon the superior sloping sides the tertiary radials. In the ray on the left of the azygous area there are three tertiary radials in each literal series and two in each of the proximal series, the second of which are axillary and bear upon the superior sides quaternary radials, and thus there are six arm openings to the vault in this ray. If the rays are uniform in this respect there are thirty arms in this species. Three of them are evidently alike in this regard, and we have no reason to think the other two are different, but they are so injured in our specimen that it cannot be definitely determined.

There are two small intertertiary radials, one following the other in each ray. There are eight plates in each regular interradial area, the first one is hexagonal, larger than a second primary radial, and it is followed by two plates in the second series, three in the third and two in the fourth which connect through a sharply depressed sunken area with the plates of the vault. There are eleven plates in the azygous area, the first one is rather larger than a first primary radial and in line with them, it is followed by two plates in the second series, three in the third, three in the fourth and two in the fifth, which connect in a sharply depressed area with the plates of the vault.

The vault is covered with large polygonal plates, each one of which is possessed of a remarkably large ventricose central node. It is sharply depressed toward the interradial areas and bears a large subcentral proboscis, which is broken off in our specimen at the summit of the vault.

This species is distinguished by its great size, the number of arms, the number and position of the plates in the interradial and azygous areas and the ventricose nodes on the surface.

Found in the Keokuk Group in Tennessee, and now in the collection of Wm. F. E. Gurley.

ALLOPROSALLOCRINUS CELSUS, n. sp.

Plate IV, Fig. 9, view opposite azygous area; Fig. 10, azygous view of same; Fig. 11, basal view of same specimen.

This species has a vault considerably higher than its greatest diameter, and most ventricose opposite the azygous side. The calyx is convex, at the basals, flat over the radial areas and moderately depressed in the interradial areas. The plates are all nodose or subspinous. The column is round, radiately furrowed and pierced by a large cinque foil columnar canal.

The basals are of equal size, have an hexagonal outline and form, a nodose rim around the end of the column. First radials bear a high, transverse, sharp node. Second radials, short, wide, quadrangular. Third radials pentagonal, small; three of them bear upon each of the upper sloping sides, three secondary radials giving two arms to each of the three rays. The other two rays adjoin the azygous area and the most distant sloping sides of the third radials bear three secondary radials and the proximal sloping sides bear a tertiary radial which is axillary and bears upon each of the upper sloping sides three tertiary radials, which gives to each of these rays three arms. There are, therefore, twelve arms in this species and twelve ambulacral openings to the vault.

The first regular interradials rest between the upper sloping sides of the first radials and separate the second and third primary and first secondary radials. Each of these plates bears a very large node and is followed by a single plate which in turn is followed by two plates that connect with the plates of the vault. The first azygous plate is in line with the first radials and is followed by three plates in the second range, two in the third range and two in the fourth range that connect with the plates of the vault.

The vault is somewhat conoidal, remarkably large, and covered with convex, tumid and subspinous plates.

Found in the Warsaw Group, in Tennessee, and now in the collection of Wm. F. E. Gurley.

DORYCRINUS GREENEI, n. sp.

Plate V, Fig. 1, basal view; Fig. 2, azygous side view, injured in the region of the opening; Fig. 3, summit view, showing the broken bulb over the azygous side and part of the plates over two rays.

Species large and robust. Calyx rudely pentagonal in outline, by reason of the elevated radial ridges; broadly truncated below for the attachment of a large column; breadth two and a half times as much as the height to the base of the arms; plates very thick and more or less convex; radial ridges, increasing in convexity as far the third primary radials, the upper parts of which are directed nearly horizontally; sutures beveled; surface sculptured.

Basals form a short subhexagonal disc, gently concave below for the attachment of the column, and pierced by a round or slightly cinque foil opening for the columnar canal. First radials large, of unequal size, rapidly expanding to the lateral angles, one-half wider than higher, three hexagonal and two heptagonal; the two hexagonal plates adjoining the azygous area are smaller than the others. Second radials about two-thirds the size of the first and of unequal size and shape; the one opposite the azygous area is quadrangular, and twice as wide as high, and anchylosed with the third radial, so the suture is very indistinct in our specimen. The others are more or less distinctly hexagonal, depending upon the truncation of the superior lateral angles, by the adjacent interradials; some of the angles are broadly truncated, and others barely touched. The second radials are much more convex longitudinally than the first, which gives the calyx at this place a marked pentagonal outline. The third radials are of very unequal size, smaller than the second, from one and a half to two and a half times as wide as high, pentagonal, axillary, and have the superior angles directed almost horizontally, and from these plates upward the rays are all directed horizontally. The third radial on the right of the azygous area bears upon each upper sloping side a single secondary radial which is short, wide, pentagonal and axillary, and bears upon each upper sloping side at least three tertiary radials before the arms are free from the plates of the vault. This arrangement gives to this ray four arms. The third primary radials in each of the other four radial series bear upon the left upper sloping side a single secondary radial, which bears upon its upper sloping sides at least three tertiary radials, but the other sloping side of the third radial bears only secondary radials, which gives to each of these four radial series three arms. The species, therefore, possesses sixteen arms before they become free from the plates of the calyx and vault. The arms consist of a single series of transverse plates, but we know nothing of what bifurcations, if any, take place. The plates of the vault and interradial areas cover the top and sides of these horizontal extentions of the secondary and tertiary radials, leaving the interradial areas deeply depressed between them.

The first regular interradial, in each area, is a large plate that rests between the superior sloping sides of the first primary radials, separates the second primary radials, and supports upon its upper sloping sides two rather large plates that separate the secondary and tertiary radials. These plates in the second interradial range unite with the plates of the vault and the sides of the projecting radial series, but our specimen is too much injured to follow further the order of arrangement.

The first azygous plate is heptagonal, of the same size and in line with the first primary radials. It is followed by three rather large plates in the second range, that separate the second primary radials, and, in turn, these are succeeded by a range of five somewhat smaller plates that separate the adjacent secondary and tertiary radials. The third range, as thus indicated, is succeeded by ranges of plates that cross the wide azygous area and form the sides of the projecting radial series and thus unite with and become part of the plates belonging to the vault. The graduation from the plates of the calyx to those of the vault leave no definite line of separation between them.

The vault is convex and possessed of a balloon-like prominence on the azygous side, part of which only is preserved in our specimen, but it is certainly peculiar and distinct from that belonging to any other described species. The opening appears to have been seven or eight ranges of plates higher than the third range of plates in the azygous area. All the radial areas are high, with abruptly descending interradial areas to correspond with the horizontally projecting arms above described. The plates of the vault and balloon-shaped prominence are large, convex and polygonal, with a smooth or finely granular surface. The plates directly over the junction of the ambulacral passages bear spines and each one over the junction of the ambulacral passages belonging to the five radial series is particularly robust, though not of great length. Our specimen is too much injured upon the vault for a minute and careful definition of it, but the injury is mechanical and what we have is in a good state of preservation.

This is a remarkable species, and quite distinct from all hitherto described, though we think it is clearly referable to *Dorycrinus*.

Found by G. K. Greene, in whose honor we have proposed the specific name, in what is called the Knobstone Group, at Button Knobs, in Bullitt county, Kentucky, and which we suppose is the age of the Keokuk Group. The specimen described is now in the collection of Wm. F. E. Gurley.

BATOCRINUS COPIOSUS, n. sp.

Plate V, Fig. 5, azygous view of calyx and vault; Fig. 6, opposite view of same, specimen slightly compressed.

Body rather above medium size. Calyx broadly truncated at the base, one-half wider than high, arm openings directed twenty degrees above a horizontal line; plates thick, convex; sutures distinct; surface granular.

Basals short, thick, and forming a low, hexagonal cup, four times as wide as high, with a round hemispherical depression radiately furrowed for the attachment of the column. The thickness of the plates outside the column is about equal to half its diameter. They stand upright and are beveled toward the sutures. First radials the largest plates in the calyx, twice as wide as high, unequal in size, three hexagonal, two heptagonal, and each one bears a highly convex, transverse, obtusely angular ridge. Second radials small, quadrangular, and more than twice as wide as long. Third radials small, pentagonal, rather wider than the second, about twice as wide as high, axillary, and bear upon each upper sloping side the secondary radials. There are two secondary radials in each series except in one opposite the azygous area where there are four secondary radials upon each side of the third radial. The first secondary radials in the four series are small and quadrangular. The second secondary radials in the four series are rather large, wide plates, bearing a transverse ridge, axillary, and support upon each upper sloping side three tertiary radials. There are, therefore, four arms, in each of four series, and two arms in the ray opposite the azygous side, or eighteen arm openings to the vault.

There is only a single regular interradial in each area, one has nine sides, another ten, another eleven and the other twelve sides. Each one bears a prominent central node. There are four plates in the azygous area; the first one is larger than a regular interradial, is in line with the first radials, though somewhat higher, and bears a transverse convex ridge, it is followed by three plates, each about the size of a regular interradial and each bearing a central node.

The vault is quite as large as the calyx, most ventricose on one side, and bears a subcentral proboscis. It is covered by large, nodose, polygonal plates. There are two pores penetrating the vault between each of the radial series.

There is of course some resemblance between all species of *Batocrinus* having, as in this case, a subequal calyx and vault; but there is no necessity for comparing this species with any of them bearing eighteen arms, as the least care will distinguish it.

Found in the Kaskaskia Group, on Little Barren river, and now in the collection of Wm. F. E. Gurley.

BATOCRINUS SACCULUS, n. sp.

Plate V, Fig. 7, view of calyx, vault and part of the column, opposite the azygous area; Fig. 8, basal view, azygous side up; Fig. 9, summit view of same, azygous side down.

Body medium size. Calyx somewhat saucer-shaped, three times as wide as high; arms directed horizontally; plates convex; sutures distinct; surface granular. Our specimen is a little depressed below, so as to produce an unnatural concavity around the column, and, therefore, does not show the full height of the calyx; it appears to be four times as wide as high, but remove the depression and it will not be more than three times as wide as high. The column is round, and plates rather thick and beveled toward the sutures so as to make them sharply angular in the middle.

Basals small, low, and extending only a little beyond the column. First radials small, one-half wider than high. Second radials two-thirds as large as the first, quadrangular and only a little wider than long. Third radials very little larger than the second, four pentagonal, the one opposite the azygons area heptagonal, axillary and bear upon each upper sloping side the secondary radials. There are two secondary radials in each series, four of which are axillary and bear upon each upper sloping side a tertiary radial. In the ray opposite the azygous area the second secondary radials are rather large and bear the free arms. This gives to the species eighteen arms. The arms are small and directed horizontally.

There are three plates in each regular interradial area, the first are the larger plates of the calyx, and each is followed by two rather long plates. In one or two of the areas there is a small plate above these. The first azygous plate is a little larger than the first radials and it is followed by four plates in the second series; above these the sutures are obscure in our specimens but apparently there are three in the third series and above these there is one or two plates that connect with the plates of the vault.

The vault is convex, most venticose on the side opposite the azygous area. It is fully as large as the calyx and bears a very small subcentral proboscis. It is covered with rather large, polygonal, convex plates, and is slightly depressed in the interradial reas.

This species somewhat resembles in form, *B. spergenensis*, but differs in the interradial and azygous areas, beside that is a twenty armed species while this has only eighteen. It will not be mistaken for any hitherto described.

Found in the Warsaw group, in Washington county, Indiana, and now in the collection of Wm. F. E. Gurley.

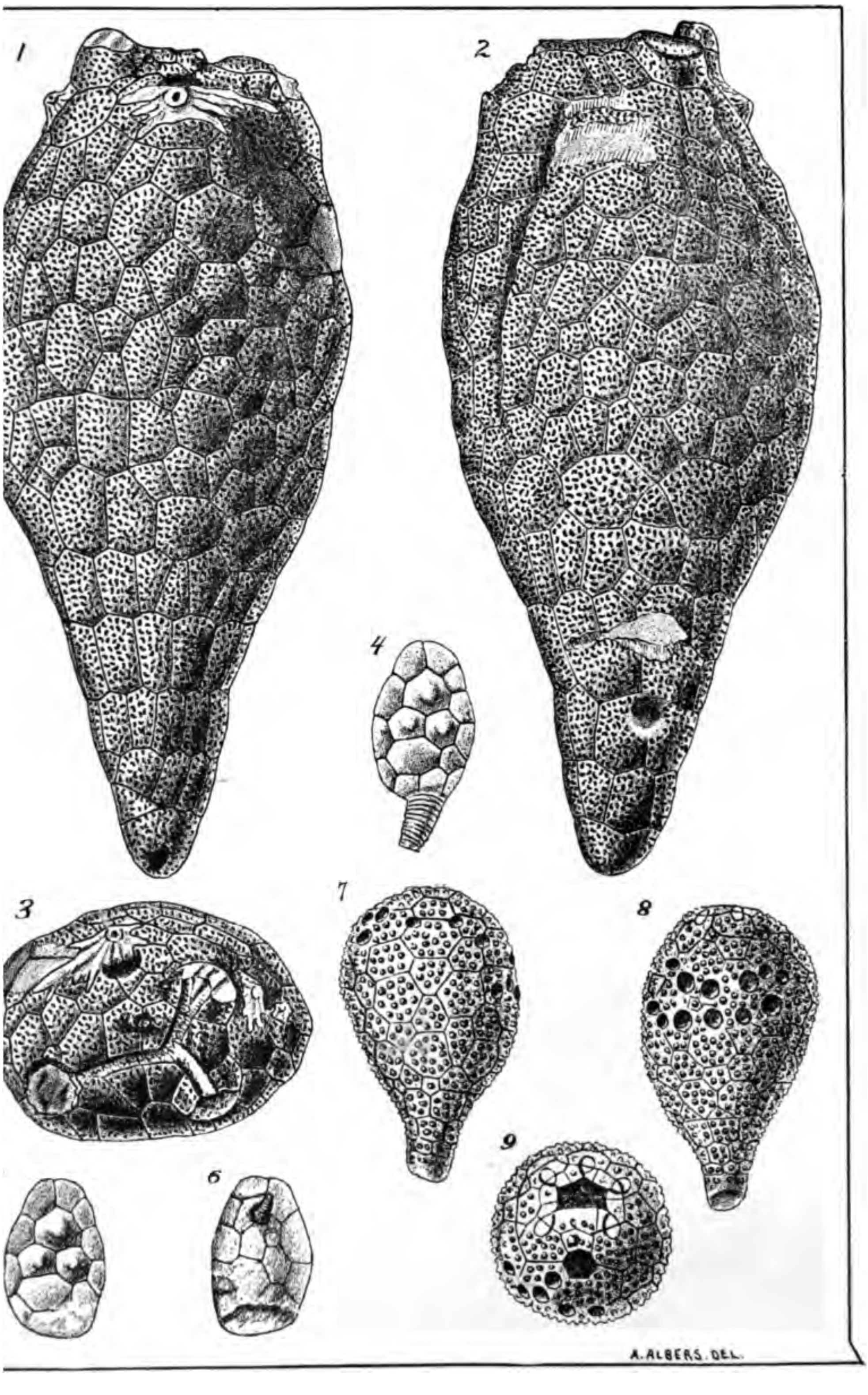
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PLATE II.

PAGE.

Archæocrinus peculiaris, n. sp. 17
Fig. 1. Lateral view.
Fig. 2. Azygous side view.
Fig. 3. Basal view.

Mitrocrinus wetherbyi, n. sp. 22
Fig. 4. Azygous side view.
Fig. 5. Basal view.
Fig. 6. Summit view.

Archæocrinus asperatus, n. sp. 19
Fig. 7. Basal view.
Fig. 8. Summit view.
Fig. 9. Azygous side view.

Æsiocystites priscus, n. sp. 14
Fig. 10. Summit view.
Fig. 11. Summit view of another specimen.
Fig. 12. Lateral view.

Caryocrinus ellipticus, n. sp. 10
Fig. 13. Anterior side view.
Fig. 14. Summit view.

Caryocrinus bulbulus, n. sp. 11
Fig. 15. Anterior side view.
Fig. 16. Posterior side view.
Fig. 17. Summit view.
Fig. 18. Basal view.

Porocrinus kentuckiensis, n. sp. 24
Fig. 19. Lateral view.

Carabocrinus ovalis, n. sp. 25
Fig. 20. Azygous side view.
Fig. 21. Opposite side of same specimen.

Retiocrinus alveolatus, n. sp. 26
Fig. 22. Azygous side view.

Glyptocrinus mercerensis, n. sp. 28
Fig. 23. Azygous side view.

Calceocrinus kentuckiensis, n. sp. 29
Fig. 24. Anterior side view.
Fig. 25. Posterior side view.

Archæocrinus parvus, n. sp. 21
Fig. 26. Basal view.
Fig. 27. Azygous side view.
Fig. 28. Summit view.

Poteriocrinus circumtextus, n. sp. 31
Fig. 29. Azygous side view.
Fig. 30. Opposite side of same specimen.

Zeacrinus grandiculus, n. sp. 32
Fig. 31 Azygous side view.
Fig. 32. Opposite side of same specimen.

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Bulletin No 5. Plate II.

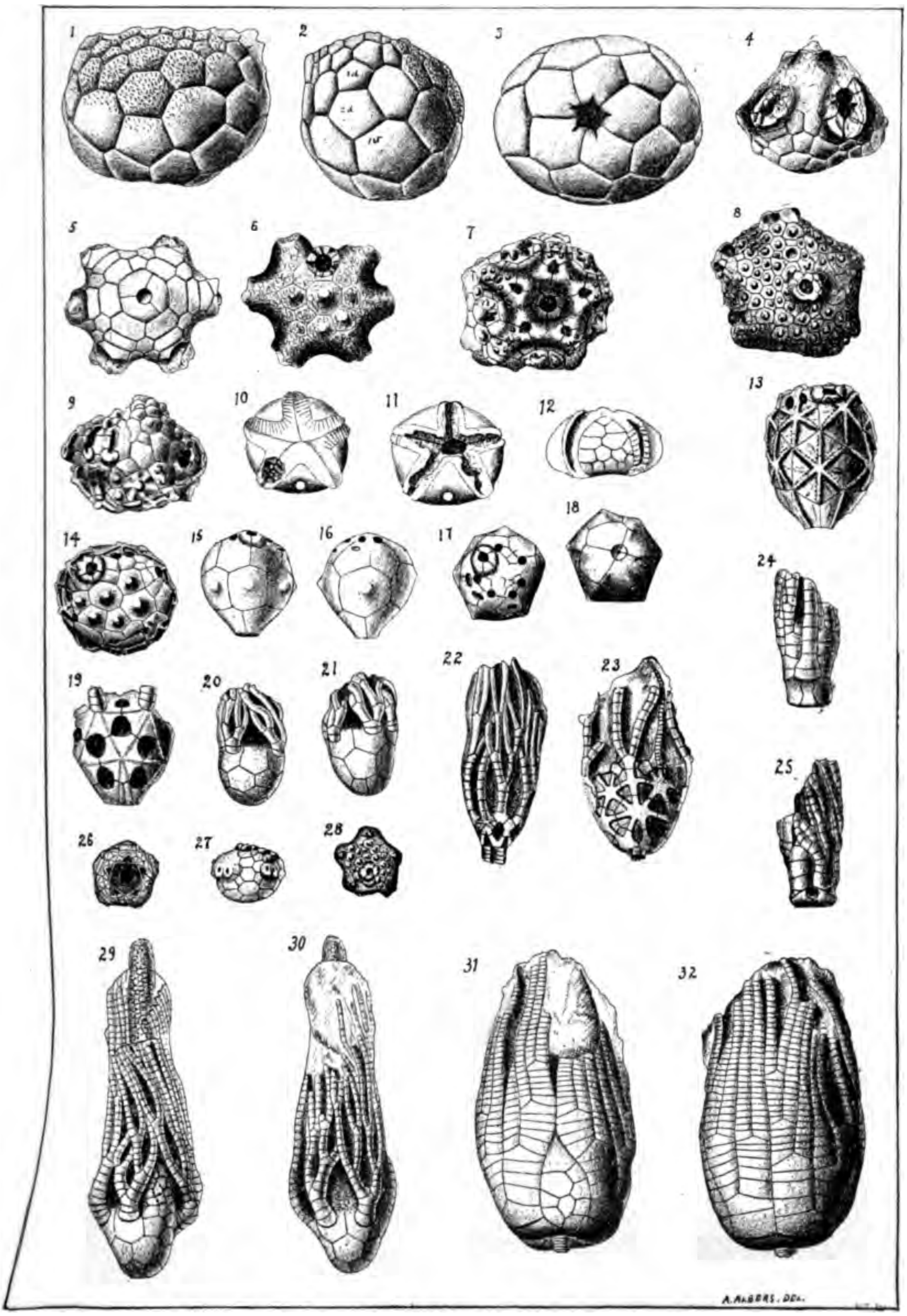


PLATE II.

PAGE.

ARCHÆOCRINUS PECULIARIS, n. sp. 17
- Fig. 1. Lateral view.
- Fig. 2. Azygous side view.
- Fig. 3. Basal view.

MITROCRINUS WETHERBYI, n. sp. 22
- Fig. 4. Azygous side view.
- Fig. 5. Basal view.
- Fig. 6. Summit view.

ARCHÆOCRINUS ASPERATUS, n. sp. 19
- Fig. 7. Basal view.
- Fig. 8. Summit view.
- Fig. 9. Azygous side view.

ÆSIOCYSTITES PRISCUS, n. sp. 14
- Fig. 10. Summit view.
- Fig. 11. Summit view of another specimen.
- Fig. 12. Lateral view.

CARYOCRINUS ELLIPTICUS, n. sp. 10
- Fig. 13. Anterior side view.
- Fig. 14. Summit view.

CARYOCRINUS BULBULUS, n. sp. 11
- Fig. 15. Anterior side view.
- Fig. 16. Posterior side view.
- Fig. 17. Summit view.
- Fig. 18. Basal view.

POROCRINUS KENTUCKIENSIS, n. sp. 24
- Fig. 19. Lateral view.

CARABOCRINUS OVALIS, n. sp. 25
- Fig. 20. Azygous side view.
- Fig. 21. Opposite side of same specimen.

RETIOCRINUS ALVEOLATUS, n. sp. 26
- Fig. 22. Azygous side view.

GLYPTOCRINUS MERCERENSIS, n. sp. 28
- Fig. 23. Azygous side view.

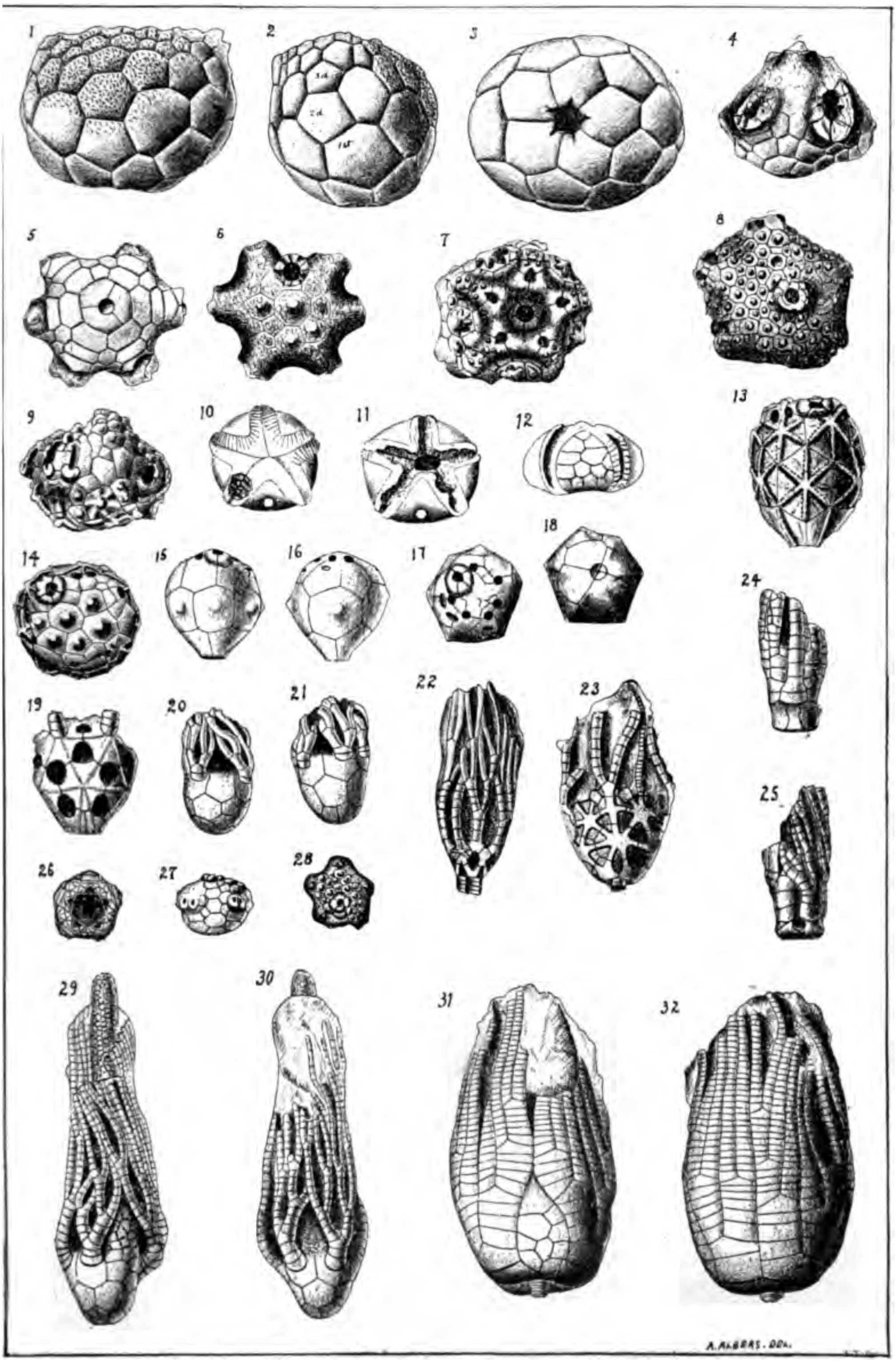
CALCEOCRINUS KENTUCKIENSIS, n. sp. 29
- Fig. 24. Anterior side view.
- Fig. 25. Posterior side view.

ARCHÆOCRINUS PARVUS, n. sp. 21
- Fig. 26. Basal view.
- Fig. 27. Azygous side view.
- Fig. 28. Summit view.

POTERIOCRINUS CIRCUMTEXTUS, n. sp. 31
- Fig. 29. Azygous side view.
- Fig. 30. Opposite side of same specimen.

ZEACRINUS GRANDICULUS, n. sp. 32
- Fig. 31. Azygous side view.
- Fig. 32. Opposite side of same specimen.

Plate II.



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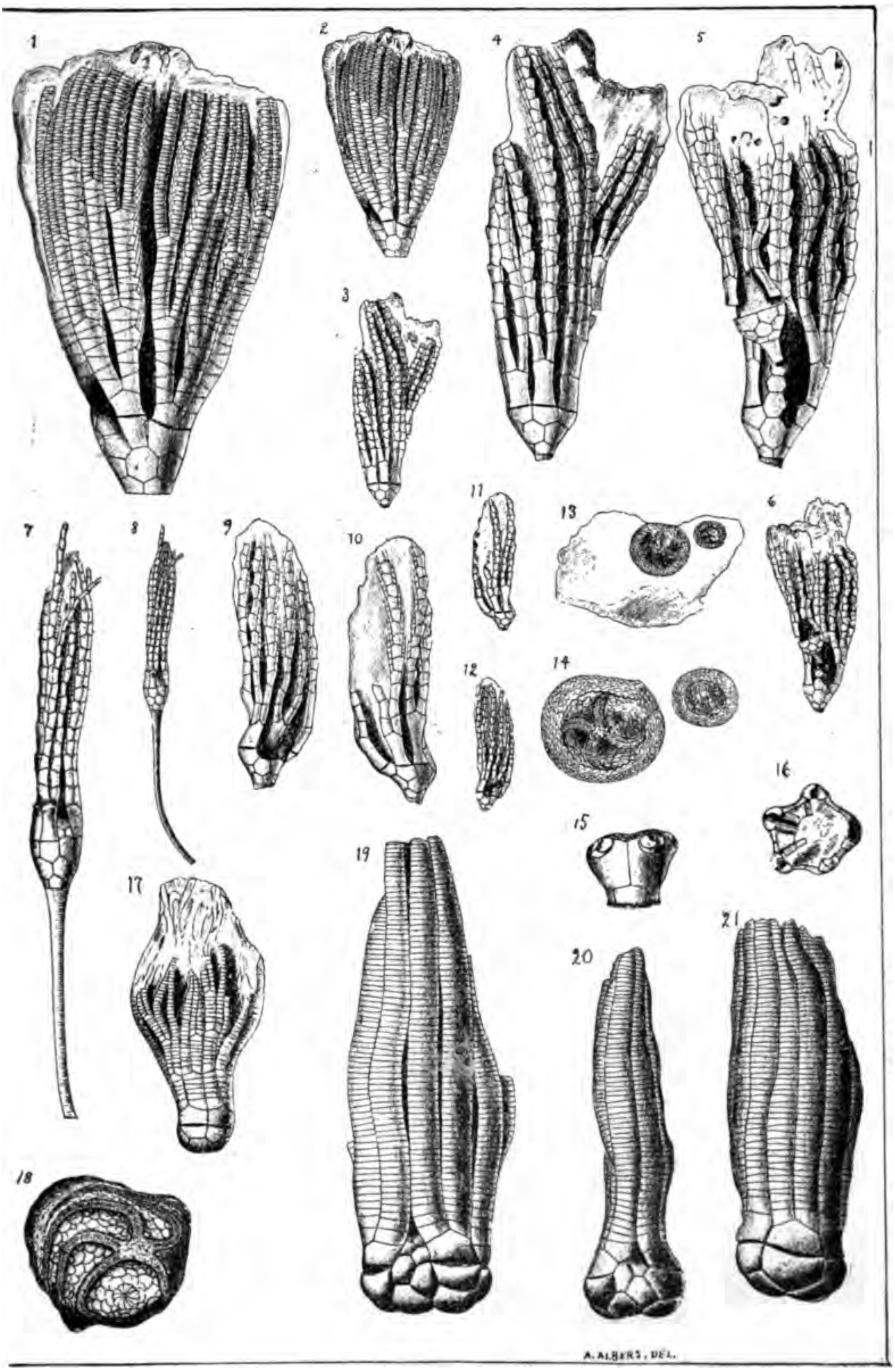
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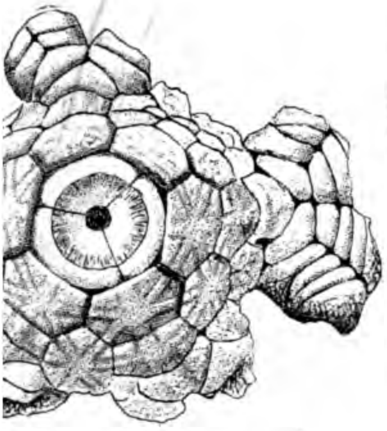

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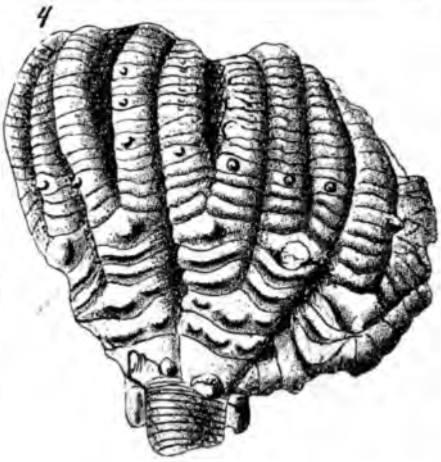

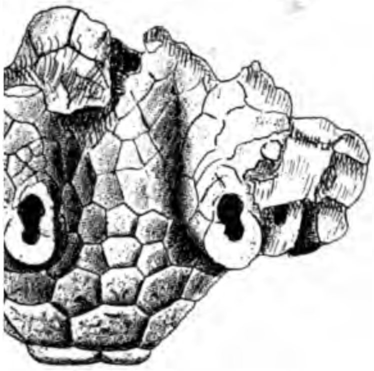

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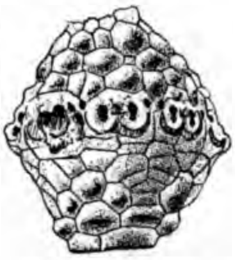

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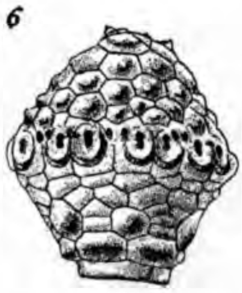

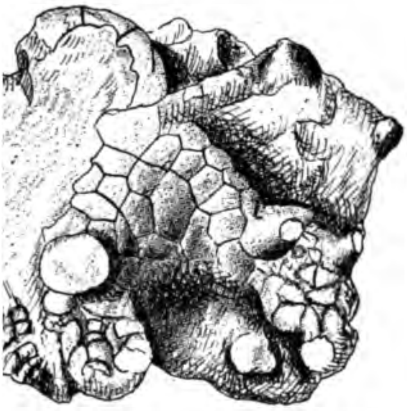

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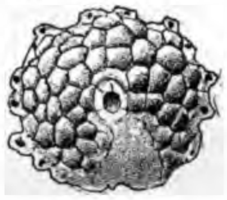

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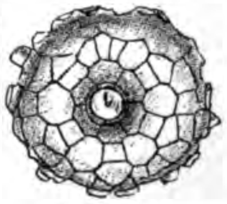

J C Branner

BULLETIN NO. 6

OF THE

ILLINOIS STATE MUSEUM

OF

NATURAL HISTORY

DESCRIPTION OF NEW SPECIES OF PALÆOZOIC ECHINODERMATA.

By S. A. MILLER and WM. F. E. GURLEY.

SPRINGFIELD, ILLINOIS,
APRIL 5, 1895.

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SPRINGFIELD, ILLINOIS.

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State Geologist and Curator.

DESCRIPTION OF NEW SPECIES OF PALÆOZOIC ECHINODERMATA.

BY S. A. MILLER AND WM. F. E. GURLEY.

SUBKINGDOM ECHINODERMATA.

CLASS CRINOIDEA.

ORDER PALÆOCRINOIDEA

FAMILY ACTINOCRINIDÆ.

BATOCRINUS SPINOSUS, n. sp.

Plate I, Fig. 1, azygous side; Fig. 2, opposite view; Fig. 3, basal view of the same specimen, azygous side down.

This species is above medium size. The calyx is short, three times as wide as high, subpentagonal in outline. The vault is high and inflated. All the plates of the body are produced in wedge-shaped, irregular spines, part of which are broken off our specimen.

Basals short and forming a low, saucer-shaped cup, with a moderately concave depression below, for the attachment of the column. First primary radials twice as wide as long, and each bearing a transverse, wedge-shaped spine, directed downward, that extends lower than the facet for the columnar attachment. Second primary radials short, about three times as wide as long, quadrangular. Third primary radials, wider than long, pentagonal, axillary, and in four rays there is a single secondary radial upon one superior sloping side which is axillary and bears upon each upper side three tertiary radials, and upon the other superior side there are three secondary radials, which arrangement gives to each of the four rays three arms. In the ray opposite the azygous area, the third primary radial bears upon each upper side three secondary radials and consequently has only two arms. There are, there-the furrows belonging to the quaternary series of radials, and at the inferior angles of these elongated plates there are pores penetrating the vault, making, in all, forty of these so-called ovarian orifices.

This species is distinguished by its general form, sharp radial ridges, tumid and nodose plates, and twenty-six arms. It is not necessary to make any special comparison with any heretofore described.

Found by Prof. A. G. Wetherby in the Keokuk Group, in Allen County, Kentucky, and now in the collection of Wm. F. E. Gurley.

BATOCRINUS CASULA, n. sp.

Plate I, Fig. 7, azygous view; Fig. 8, side view of the same specimen, part being broken away opposite the azygous side

Species large, calyx and vault subequal in size. Calyx one-half wider than high, bowl-shaped, most rapidly expanding above the secondary radials, and ambulacral openings directed nearly horizontally. Radial ridges angular and in the tertiary and quaternary series embracing the entire plates to the lateral sutures, and each plate bears a central node. All the plates of the calyx are tumid and each bears one or more nodes. Surface granular. Column large.

Basals short, twice as wide as high, bear a tubercle at each side, and form a low hexagonal disc, one-half wider than the column, each superior face concave and lateral sutures deep. First primary radials of unequal size, from one-half wider to twice as wide as long, superior face transverse or slightly concave, three hexagonal, two heptagonal and each bears a central node, and the larger ones have small lateral nodes. Second primary radials comparatively small, quadrangular, and about one-half wider than high. Third primary radials about one-half larger than the second, pentagonal, axillary, and support on each upper sloping side two secondary radials, and in one of the rays in our specimen there are three secondary radials. The secondary radials are larger than the second and third primaries, and the last one is axillary in all the rays. Above this some of the rays are injured in our specimen. The lateral ray shown in figure 8 has four tertiary radials upon each upper sloping side of the last secondaries which gives to this ray four arms. The ray shown on the right of the azygous area in figure 7 has four tertiary radials on each of the upper proximal sides of the second secondaries, and two tertiary radials on each of the upper distal sides, the last of which is axillary and supports upon each upper side three quaternary radials, Basals very short, wide, truncated below, lateral sutures deep, superior face of each concave, truncated face about twice the diameter of the column, the facet for which is only moderately concave and radiately furrowed. First primary radials of unequal size, from two to four times as wide as long, superior face concave, three hexagonal, two heptagonal, and each bears three nodes, one central from which the angular radial ridge arises, and one on each prolonged lateral side. Second primary radials of unequal size, from one and a half to two and a half times as wide as long, quadrangular. Third primary radials about one half larger than the second, pentagonal, axillary and support on each upper sloping side, two secondary radials. The secondary radials are as large as the second and third primaries. The second secondary radials are axillary, and, in three rays, bear upon one of the superior sloping sides two tertiary radials, the second one of which is axillary and bears upon each superior sloping side three quaternary radials, and upon the other side of the second secondary radials, which are the proximal sides, four tertiary radials, which arrangement gives to each of the three rays six arms. In the ray opposite the azygous area and in one of the lateral rays each second secondary radial is axillary and bears upon each upper sloping side four tertiary radials, and consequently these rays have four arms. There are, therefore, twenty-six arms in this species and twenty-six ambulacral openings to the vault. There are no intersecondary or intertertiary plates.

In two of the regular interradial areas there is one large plate followed by a small one, and in the other two areas there is a large plate followed by two small ones. These plates are tumid and each bears a central node. The azygous area is somewhat trapezoidal in outline and contains seven plates. The first one is in line with the first primary radials, but is much larger than either of them and bears a large transverse wedge-shaped spine. It is followed by three tumid, nodose plates in the second range, and these, in turn, by two plates, one of which is quite small, and above the larger plate, in the third range, there is a small plate in the fourth range, which is immediately below the angle formed by the union of the first quaternary plates.

Vault high, broadly rounded, most tumid opposite the azygous side and covered with polygonal, nodose plates. The larger plates bear two, three or more nodes, but the smaller ones bear a single central node. The proboscis is subcentral on the azygous side. There are narrow, elongated plates at the base of the vault, between the plates covering the ambulacral furrows, except between

BATOCRINUS HONORABILIS, n. sp.

Plate I, Fig. 9, azygous view; Fig. 10, opposite side same specimen.

Species large, with a vault less than half the height of the calyx. Calyx nearly as long as wide, hexagonal below and most rapidly expanded near the top. Plates tumid and subspinous, Ambulacral openings directed upward at an angle of thirty degrees. Column large and radiately furrowed.

Basals stand upright and form a hexagon about twice as wide as high and about twice as wide as the diameter of the column. They are beveled towards the sutures and flattened on the sides and extend to wedge-shaped end below the commencement of the column, so that the calyx will stand on the cuneiform edges. First primary radials large, nearly as long as wide, three hexagonal, two heptagonal. Second primary radials a little wider than long, quadrangular. Third primary radials abut upon two interradials at one or both ends, and consequently four of them are hexagonal and one heptagonal; the heptagonal plate is shown in figure 10. They are very unequal in size, but each one is axillary and supports upon each of its two superior sides two secondary radials. The secondary radials are rather long and as large as the second and third primary radials, the second secondary radials are axillary and each supports on its superior sloping sides three tertiary radidals, and in some rays four tertiary radials. By this arrangement there are four arms in each radial series or twenty arms and twenty ambulacral openings to the vault in this species. There are no intersecondary or intertiary plates.

The regular interradial arms are much elongated and the two shown in figure 10 have each four plates, one in the first range, two in the second and one in the third. But in each of the other regular interradial areas there are three plates in line, the third one being the smallest. In the azygous area there are seven plates and it is somewhat trapezoidal in outline. The first one is as long as wide, larger than a first primary radial and in line with them. It is followed in the second range by three large plates and these by two in the third range and one in the fourth, which separates the first tertiary radials, and in these rays there are four tertiary radials.

The vault is subhemispherical or broadly rounded and bears a small subcentral proboscis which is broken off in our specimen. It is covered with large, tumid, polygonal plates, each of which bears a central mode. The interradial areas are slightly depressed between each pair of arms where there is an elongated plate and an orifice at each of its inferior angles. This arrangement places one pore on one side of each arm or gives to the species twenty of these so-called ovarian pores.

This species is distinguished by its general form, cuneiform basal plates, elongated interradial areas, twenty arms and nodose plates. It cannot be mistaken for any hitherto described.

Found by Prof. A. G. Wetherby, in the Keokuk Group of Tennessee and now in the collection of Wm. F. E. Gurley.

BATOCRINUS WETHERBYI.

Plate I, Fig. 11, azygous view; Fig. 12, opposite side of same specimen. The outer rim of the basals is broken off.

Species rather above medium size, biturbinate vault larger than the calyx. Plates of the vault tumid and nodose, while those of the calyx are smooth. Calyx twice as wide as high, truncated and expanded at the base, and broadly constricted in the region of the secondary radials, and having the last tertiary radials directed nearly horizontally. The surface is without radial ridges or other ornamentation except a granular covering.

The basals are truncated below and broadly expanded, but the outer rim is broken off in our specimen so the true diameter is not disclosed. The column is large and inserted in a concave radiately furrowed depression. The first primary radials are very short, from three to four times as wide as long, superior face concave, three hexagonal and two heptagonal. Second primary radials short, from two to three times as wide as long, quadrangular. Third primary radials very little larger than the second, pentagonal, axillary and supports on each superior sloping side two secondary radials. The secondary radials are larger than the second and third primary radials and considerably wider. The second secondary radials are axillary and bear on each superior sloping side two rather long tertiary radials. By this arrangement there are twenty arms and twenty ambulacral openings to the vault.

There is a single very large plate in each of two regular interradial areas and two plates in each of the other two areas, one rather large plate followed by a small one as shown in figere 12. There are five azygous plates. Tho first one is much larger than either of the first primary radials and in line with them. There are three plates in the second range, the middle one being much the smallest and quadrangular. There is a single wide plate in the third range which is nearly as large as the first. The azygous area is, therefore, nearly square in outline, with a small quadrangular plate in the center surrounded by four plates in the angles of the area.

BATOCRINUS HONORABILIS, n. sp.

Plate I, Fig. 9, azygous view; Fig. 10, opposite side same specimen.

Species large, with a vault less than half the height of the calyx. Calyx nearly as long as wide, hexagonal below and most rapidly expanded near the top. Plates tumid and subspinous, Ambulacral openings directed upward at an angle of thirty degrees. Column large and radiately furrowed.

Basals stand upright and form a hexagon about twice as wide as high and about twice as wide as the diameter of the column. They are beveled towards the sutures and flattened on the sides and extend to wedge-shaped end below the commencement of the column, so that the calyx will stand on the cuneiform edges. First primary radials large, nearly as long as wide, three hexagonal, two heptagonal. Second primary radials a little wider than long, quadrangular. Third primary radials abut upon two interradials at one or both ends, and consequently four of them are hexagonal and one heptagonal; the heptagonal plate is shown in figure 10. They are very unequal in size, but each one is axillary and supports upon each of its two superior sides two secondary radials. The secondary radials are rather long and as large as the second and third primary radials, the second secondary radials are axillary and each supports on its superior sloping sides three tertiary radidals, and in some rays four tertiary radials. By this arrangement there are four arms in each radial series or twenty arms and twenty ambulacral openings to the vault in this species. There are no intersecondary or intertiary plates.

The regular interradial arms are much elongated and the two shown in figure 10 have each four plates, one in the first range, two in the second and one in the third. But in each of the other regular interradial areas there are three plates in line, the third one being the smallest. In the azygous area there are seven plates and it is somewhat trapezoidal in outline. The first one is as long as wide, larger than a first primary radial and in line with them. It is followed in the second range by three large plates and these by two in the third range and one in the fourth, which separates the first tertiary radials, and in these rays there are four tertiary radials.

The vault is subhemispherical or broadly rounded and bears a small subcentral proboscis which is broken off in our specimen. It is covered with large, tumid, polygonal plates, each of which bears a central mode. The interradial areas are slightly depressed between each pair of arms where there is an elongated plate and an orifice at each of its inferior angles. This arrangement places one pore on one side of each arm or gives to the species twenty of these so-called ovarian pores.

This species is distinguished by its general form, cuneiform basal plates, elongated interradial areas, twenty arms and nodose plates. It cannot be mistaken for any hitherto described.

Found by Prof. A. G. Wetherby, in the Keokuk Group of Tennessee and now in the collection of Wm. F. E. Gurley.

BATOCRINUS WETHERBYI.

Plate I, Fig. 11, azygous view; Fig. 12, opposite side of same specimen. The outer rim of the basals is broken off.

Species rather above medium size, biturbinate vault larger than the calyx. Plates of the vault tumid and nodose, while those of the calyx are smooth. Calyx twice as wide as high, truncated and expanded at the base, and broadly constricted in the region of the secondary radials, and having the last tertiary radials directed nearly horizontally. The surface is without radial ridges or other ornamentation except a granular covering.

The basals are truncated below and broadly expanded, but the outer rim is broken off in our specimen so the true diameter is not disclosed. The column is large and inserted in a concave radiately furrowed depression. The first primary radials are very short, from three to four times as wide as long, superior face concave, three hexagonal and two heptagonal. Second primary radials short, from two to three times as wide as long, quadrangular. Third primary radials very little larger than the second, pentagonal, axillary and supports on each superior sloping side two secondary radials. The secondary radials are larger than the second and third primary radials and considerably wider. The second secondary radials are axillary and bear on each superior sloping side two rather long tertiary radials. By this arrangement there are twenty arms and twenty ambulacral openings to the vault.

There is a single very large plate in each of two regular interradial areas and two plates in each of the other two areas, one rather large plate followed by a small one as shown in figure 12. There are five azygous plates. The first one is much larger than either of the first primary radials and in line with them. There are three plates in the second range, the middle one being much the smallest and quadrangular. There is a single wide plate in the third range which is nearly as large as the first. The azygous area is, therefore, nearly square in outline, with a small quadrangular plate in the center surrounded by four plates in the angles of the area.

The vault is high, subconical with a large subcentral proboscis. It is covered with large, tumid, nodose, polygonal plates. The interradial areas are slightly depressed between each pair of arms, where there is a narrow elongated plate and an orifice at each of its inferior angles. This arrangement places one pore on one side of each arm or gives to the species twenty of these so-called ovarian apertures.

This species is distinguished by its general biturbinate form, expanded basals, smooth calyx, nodose vault, square azygous area and twenty arms. It is a marked species that need not be mistaken for any heretofore described.

Found by Prof. A. G. Wetherby, in whose honor we have proposed the specific name, in the Keokuk Group, at White Creek Springs, in Tennessee, and now in the collection of Wm. F. E. Gurley.

BATOCRINUS LATERNA, n. sp.

Plate I, Fig. 13, azygous area on the right; Fig. 14, basal view to show the diameter of the basal plates.

Species rather above medium size and having a lantern shape that suggested the specific name. Vault conical and larger than the calyx. Calyx more than twice as wide as high; basals thin and remarkably expanded in a circular disc; each radial series consists of a sharp ridge that slopes laterally to the sutures, while the interradial areas are flattened and depressed so that a transverse section of the calyx, at any point below the secondary radials, will be sharply pentagonal in outline. The calyx is abruptly expanded above the secondary radials so that the last tertiary radials are directed horizontally, in pairs, with a depressed interradial space between them. The angularity of the radial ridges is somewhat like it is in *Batocrinus curiosus*, but otherwise the calyces have no resemblance to each other.

The basals form a thin circular disc that has a diameter one-half greater than the height of the calyx, and, in the center of which, on the lower flat side, there is a concave radiately furrowed depression for the attachment of the column, and a small round columnar canal. The diameter of the column is about one-fourth the diameter of the basal disc. The first primary radials are short, two or three times as wide as high, have a concave face for the second radials, are longitudinally sharply angular in the middle, and appear as if set down upon the surface of the plane basal disc. Second primary radials short, sharply angular in the middle, quadrangular. Third primary radials very little larger than the second, pentagonal, axillary and bear upon each superior lateral side two secondary radials. The secondary radials are short, the last one axillary and supporting on each superior sloping side three tertiary radials. This arrangement gives to the species twenty arms and twenty ambulacral openings to the vault. The ambulacral openings are directed horizontally.

The regular interradial areas are depressed and flattened below the base of the radial ridges. Some of the matrix covers the plates in some of the areas so that they cannot be distinguished. In the area, on the left of figure 13, there are three plates, one in the first range and two in the second, one of which is much longer than the other. In the azygous area there are five plates. The first one is in line with the first primary radials, only about half as wide but somewhat longer than either one of them. It appears to stand up on the circular disc filling the middle part of the depressed and flattened area. It bears a small central tubercle, but all the other interradials are flat and smooth. It is followed by three rather large flat plates, in the second range, and above these, in the third range, there is a single, narrow, elongated plate that extends one angle high between the second tertiary plates, but is cut off from reaching the plates of the vault.

Vault very high, conical, larger than the calyx and bearing a large subcentral proboscis. The interradial areas are depressed between each pair of arm bases. The vault is covered with large, polygonal, and tumid plates, each one of which bears a large central node. There is a narrow elongated plate between each pair of ambulacral furrows and an orifice at each of its inferior angles. This arrangement places one pore on one side of each arm or gives to the species twenty of these so-called ovarian apertures.

The large round basal disc, pentagonal outline of the calyx, sharp radial ridges, depressed and flattened interradial areas, conical vault and twenty arms distinguish this species. There is no doubt but that the proboscis is large and long and that the basal disc is expanded, probably, beyond any other known species. Both of these characters are ascribed to *Eretmocrinus*, but there is no difficulty in showing, as we have before remarked, that the proboscis, alone, cannot be relied upon to distinguish the genera. The basal plates cannot be relied upon, for you may pass by a graded scale from the extraordinary basals, in this species, to those in *Batocrinus wetherbyi* and then to *Batocrinus curiosus* and then to *Batocrinus casula* where the basals are rounded instead of expanded. The only other character by which *Eretmocrinus* is distinguished from *Batocrinus* is found in the arms, and, as we shall have occasion to describe a species, in this paper, having the flattened arms belonging to *Eretmocrinus*, we will defer further comparison until that species is before us. If *Eretmocrinus*, however, is a valid genus, the probability is, that this species should be referred to it, in the absence of a knowledge of the arms, for, otherwise, the genus can only be known by the arms, which are rarely ever found, in chert or among silicified specimens. The species most nearly related to this one is *Eretmocrinus lyonanus*, though they are readily distinguished by the basal plates and interradial areas; differences, however, which are only specific, not generic. They both belong to the same genus.

Found by Prof. A. G. Wetherby, in the Keokuk Group, at White Creek Springs, Tennessee, and now in the collection of Wm. F E. Gurley.

BATOCRINUS LACINIOSUS, n. sp.

Plate 1, Fig. 15, view opposite the azygous area; Fig. 16, azygous side of same specimen.

Species medium size, one of our specimens is much smaller than the one illustrated. General form biturbinate; vault larger than the calyx. Calyx twice as wide as high, broadly truncated below and rapidly expanding from the secondary radials so as to direct horizontally the last tertiary radials and ambulacral openings. Plates on the lower part of the calyx tumid and subspinous, those on the superior part plane or slightly convex. Radial ridges undefined; sutures distinct.

Basals form a low hexagonal disc, one-half wider than the diameter of the column. Columnar depression concave and radiately furrowed, canal small. First primary radials large, only a little wider than long and each bears a robust, transverse, cuneiform node, three hexagonal, two heptagonal. Second primary radials very small, short, about twice as wide as long, quadrangular. Third primary radials about one-half larger than the second, pentagonal, axillary, and in the rays adjoining the azygous area, bearing on the distal sloping sides three secondary radials and on the proximal sides one secondary radial, which is axillary, and bears upon its superior sloping sides three tertiary radials, which gives to each of these rays three arms. In the two lateral rays the third primary radials bear upon each superior sloping side a single secondary radial, which is axillary and bears upon each upper sloping side three tertiary radials, which gives to each of these rays four arms. In the ray opposite the azygous area the third primary radial bears upon each upper sloping side three secondary radials which gives to this ray two arms. There are, therefore, in this species, sixteen arms and sixteen ambulacral openings to the vault.

There is a single large tumid plate in each regular interradial area. In the azygous area there are six plates. The first one is as large as a first primary radial, and in line with them, and bears equally as robust and cuneiform a spine. It is followed by three much smaller plates, in the second range, and these, in turn, by two plates, the lower one of which is much the smaller.

The vault is conical, larger than the calyx and bears a subcentral proboscis. It is covered with large subspinous plates. There is an elongated plate between each pair of arms and one dividing the three armed rays that separate the ambulacral coverings at the base of the arms and a pore penetrates the vault at each inferior angle of these narrow plates, which arrangement gives to this species eighteen of these so called ovarian apertures.

This species is distinguished by the general form, tumid plates on the lower part of the calyx and smooth plates in the superior part, azygous area and sixteen arms.

Found by Prof. A. G. Wetherby in the Keokuk Group, of Tennessee, and now in the collection of Wm. F. E. Gurley.

BATOCRINUS CASUALIS, n. sp.

Plate I, Fig. 17, view opposite the azygous area; Fig. 18, azygous view of same specimen.

Species below the average size, biturbinate, vault and calyx subequal. Calyx broadly truncated below, only slightly expanded above and ambulacral openings directed upward at an angle of forty degrees. Diameter about one fifth greater than the height. Radial ridges not distinguished. A few of the plates in the lower part tumid, those in the upper part only slightly convex or plane.

Basal plates stand upright and form an hexagonal disc three times as wide as high, truncated below, and having a deep cavity for the insertion of the column, which is a little less than half the diameter of the basal disc. Columnar canal small. First primary radials large, one-fourth wider than high, three hexagonal, two heptagonal and each bearing a robust, transverse node. Second primary radials small, quadrangular. Third primary radials a little larger than the second, pentagonal and axillary. The second and third primary radials together much smaller than the first.

This species is distinquished by its form, large azygous area connected with the vault, and peculiar azygous interradius on the vault, and eighteen arms. It cannot be mistaken for any species heretofore described.

Found by Prof. A. G. Wetherby in the St. Louis Group, in Washington county, Indiana, and now in the collection of Wm. F. E. Gurley.

BATOCRINUS PILEUS, n. sp.

Plate II, Fig. 6, basal view slightly broken; Fig. 7, summit view; Fig. 8, side view of the same specimen.

This species is rather large in circumference, with an almost flat calyx and moderately convex vault, or plano-convex in outline. The cap-like form suggested the specific name. While the calyx is nearly flat, the radial ridges are distinctly convex. Ambulacral openings directed upward at an angle of thirty degrees and not visible in a basal view.

Basal plates form a flat disc very little larger than the diameter of the attaching column. First primary radials short, more than twice as wide as long, three hexagonal, two heptagonal. Second primary radials about two-thirds as large as the first, quadrangular. Third primary radials nearly as large as the first, pentagonal, axillary, and supporting on each upper sloping side two secondary radials. The second secondary radials are axillary and bear upon each superior sloping side three tertiary radials which gives to each ray four arms. There are, therefore, twenty arms in this species and twenty ambulacral openings to the vault.

There are three plates in each regular interradial area, one moderately large followed by two smaller ones. The azygous area is subovate in outline and contains eight plates. The first one is in line with the first primary radials and narrower and longer than either of them. It is followed by three plates in the second range and three in the third range, the middle and higher one of which is truncated by a small plate that extends to the top of the calyx and unites with the plates of the vault.

The vault is convex and twice as large as the calyx, most tumid opposite the azygous side. There are three large, convex plates over each ambulacral area, one over the place where each pair of ambulacral furrows unite and the other over the point where they all come together. There are also four or more large, convex plates near the base of the proboscis on the side opposite the azygous area. The interradial areas are slightly depressed and cov-

The basals extend a little beyond the column and form a subhexagonal band around the superior end of it, with a concave depression radiately furrowed for its attachment. The canal is small and cinque foil. The first primary radials short, about three times as wide as high; three hexagonal, two heptagonal, superior side slightly concave. Second primary radials small, short, quadrangular, two are three times as wide as high. Third primary radials very little larger than the second, pentagonal, axillary, and on the distal side of the two rays adjoining the azygous area bear two secondary radials, the last of which is axillary and bears two tertiary radials on each upper sloping side, and on the proximal side having a single secondary radial, which is axillary and bears three tertiary radials. In each of the two lateral rays there are two secondary radials on each upper sloping side of the third primary radials, the second one being axillary and supporting on each upper sloping side two tertiary radials. By this arrangement there are four arms to each of these four rays. In the ray opposite the azygous area the third primary radial bears upon each upper sloping side three tertiary radials which gives to it two arms. There are, therefore, eighteen arms to this species and eighteen ambulacral openings to the vault.

In three of the regular interradial areas one large plate is followed by two small ones, in the other area there are only two plates, one following the other. The azygous 'area is somewhat triangular or conical and contains nine plates. The first one is in line with the first primary radials and somewhat smaller. It is followed by three plates of nearly equal size in the second range, and these by three plates in the third range, on the side of the highest of which there is a small plate that might be referred to a fourth range though not extending as high as the middle plate in the third range, and on the apex of the middle plate there is a single plate that extends as high as the calyx and unites with two plates connecting with the vault.

The vault is two or three times as large as the calyx, most convex or tumid opposite the azygous side and covered with large, polygonal plates, each of which bears a central node, except in the azygous interradials where the plates are small and plane or very slightly convex. It bears a large subcentral proboscis. The arms are arranged in pairs and two pores penetrate the vault between each pair of arms, which gives to this species eighteen of these so-called ovarian apertures.

This species is distinquished by its form, large azygous area connected with the vault, and peculiar azygous interradius on the vault, and eighteen arms. It cannot be mistaken for any species heretofore described.

Found by Prof. A. G. Wetherby in the St. Louis Group, in Washington county, Indiana, and now in the collection of Wm. F. E. Gurley.

BATOCRINUS PILEUS, n. sp.

Plate II, Fig. 6, basal view slightly broken; Fig. 7, summit view; Fig. 8, side view of the same specimen.

This species is rather large in circumference, with an almost flat calyx and moderately convex vault, or plano-convex in outline. The cap-like form suggested the specific name. While the calyx is nearly flat, the radial ridges are distinctly convex. Ambulacral openings directed upward at an angle of thirty degrees and not visible in a basal view.

Basal plates form a flat disc very little larger than the diameter of the attaching column. First primary radials short, more than twice as wide as long, three hexagonal, two heptagonal. Second primary radials about two-thirds as large as the first, quadrangular. Third primary radials nearly as large as the first, pentagonal, axillary, and supporting on each upper sloping side two secondary radials. The second secondary radials are axillary and bear upon each superior sloping side three tertiary radials which gives to each ray four arms. There are, therefore, twenty arms in this species and twenty ambulacral openings to the vault.

There are three plates in each regular interradial area, one moderately large followed by two smaller ones. The azygous area is subovate in outline and contains eight plates. The first one is in line with the first primary radials and narrower and longer than either of them. It is followed by three plates in the second range and three in the third range, the middle and higher one of which is truncated by a small plate that extends to the top of the calyx and unites with the plates of the vault.

The vault is convex and twice as large as the calyx, most tumid opposite the azygous side. There are three large, convex plates over each ambulacral area, one over the place where each pair of ambulacral furrows unite and the other over the point where they all come together. There are also four or more large, convex plates near the base of the proboscis on the side opposite the azygous area. The interradial areas are slightly depressed and covered with smaller polygonal plates. Most of the sutures being destroyed in our specimen, these plates are not indicated in the illustrations. The vault is broken in our specimen so as to show no part of the subcentral proboscis. Two pores penetrate the vault between each pair of arms, which gives to this species twenty of these so-called ovarian apertures.

This species is distinguished by its general form, flattened calyx, ovate azygous area connected with the vault, regular distribution of large convex plates on the vault, and twenty arms. It cannot be mistaken for any species heretofore described.

Found in the St. Louis Group, in Washington county, Indiana, and now in the collection of Wm. F. E. Gurley.

BATOCRINUS BURKETI, n. sp.

Plate II, Fig. 9, showing column, calyx and arms, azygous view.

This species is rather above medium size and is founded on a single fine specimen on a slab. Of course, it does not disclose the entire calyx and as the arms are preserved the vault cannot be seen. The calyx is nearly twice as wide as high, and subhemispherical. Though somewhat lobed in the superior part there are no radial ridges or proper evidences of surface ornamentation. The column is round, medium size, and composed, within an inch of the calyx, of rather thick plates, every alternate one projecting beyond the other; but farther removed from the calyx, the projecting plates are at irregular distances from each other as shown in the illustration.

Basals form a low hexagonal cup, more than one-half wider than the diameter of the column and bearing a small rim or truncated bottom which contains the concave depression for the insertion of the column. First primary radials large, a little wider than high, three hexagonal, two heptagonal. Second primary radials rather large and about one-half wider than high. Third primary radials differ greatly in size, and part are pentagonal and others hexagonal. The one on the left of the azygous area is only a little larger than the second primary radial, pentagonal, axillary and bears on one side three secondary radials, and on the other which adjoins the azygous area one secondary radial which is axillary and supports on each upper sloping side two tertiary radials. The arms then bifurcate on the third plate, which gives to this ray six arms. The third primary radial on the right of the azygous area is hexagonal, axillary and bears on the side adjoining the azygous area two secondary radials, and on the distal side two secondary radials, the second one of which is axillary and bears upon each superior side one tertiary radial. The arms then bifurcate on the third plate, which gives to this ray six arms. It will be noticed that these rays are quite different and yet result in producing the same number of arms. The lateral rays, as far as they can be seen, on our specimen, appear to be constructed in the same manner as the two above described. The ray opposite the azygous side may have the same number of arms and it may have two less. We can see seventeen arms, the others are covered. The species, therefore, as near as can be ascertained has either twenty-eight or thirty arms. The arms are large, long, and composed of a double series of small interlocking plates, that bear long pinnules.

The regular interradial area on the left of the azygous side is elongated, extends to the vault and contains five plates. The first is medium size and rests between the superior sloping sides of two first primary radials; it is followed by two somewhat smaller plates in the second range, and these by one of about the same size in the third range, and this by an elongated plate in the fourth range, that separates the arm-bearing plates of the calyx and unites with the plates of the vault. No other regular area can be described from our specimen. The azygous area is elongate, subovate and contains nine or more plates. The first plate is in line with the first primary radials and quite as large. It is followed by three plates in the second range, and these by three in the third range, and these by two plates in the fourth range that separate the arm-bearing plates, and one of which unites with the plates of the vault.

This species will be distinguished by its smooth calyx, slightly lobed by the projecting radial series at the summit of the calyx, and depressed interradials, that separate the arm-bearing plates; by the shape of the regular and azygous areas and the number of plates which they contain, and their connection with the plates of the vault, which is so exceedingly rare in this genus; and by the structure of the radial series and number of arms. We know of no species with which it is necessary to make a comparison, or for which it might be mistaken.

Found by Mr. N. K. Burket, in the Keokuk Group, at Hamilton, Illinois, and now in the collection of Wm. F. E. Gurley.

BATOCRINUS LABELLUM, n. sp.

Plate 2, Fig. 10, azygous side; Fig. 11, basal view; Fig. 12, summit view.

This species is medium size, depressed, biturbinate or resembling in outline a double convex lens. Calyx and vault subequal. Calyx saucer-shaped, about two and a half times as wide as high. Plates convex or transversely ridged, by being beveled toward the sutures, which are remarkably well defined. Ambulacral openings directed upwards at an angle of twenty degrees and not visible in a basal view.

The basals extend a little beyond the column and form a sub-hexagonal band around the superior end of it, with a concave depression radiately furrowed for its attachment, and in this respect, resembles *Batocrinus arcula.* First primary radials short, two or three times as wide as long, three hexagonal, two heptagonal. Second primary radials short, about twice as wide as long, quadrangular. Third primary radials a little larger than the second, three pentagonal, two hexagonal, axillary, and in four of the rays supporting upon each upper sloping side two secondary radials, the second one of which is axillary and bears upon each superior sloping side three tertiary radials which gives to each of these rays four arms. In the ray opposite the azygous area the third primary radial bears upon each upper side four secondary radials which gives to this ray two arms. There are, therefore, eighteen arms in this species and eighteen ambulacral openings to the vault.

There are three plates in each of three regular interradial areas, one large plate followed by two small ones. In the other area there are four plates, one large plate followed by two small ones in the second range and these by one in the third range. The azygous area is sub-ovate, in outline, and contains eight plates. The first is in line with the first primary radials and of about the same size. It is followed by three plates in the second range, and these by three plates in third range, above which, a single plate separates the first tertiary radials, while the second tertiary radials unite over its superior angle.

The vault is about the same size as the calyx and very much like it in outline. It is covered with numerous, tumid, polygonal plates, each of which bears a central node. There are two pores that penetrate the vault between each pair of arms or eighteen of these so-called ovarian apertures in the species.

This species is distinguished, by its general form; by the beveled plates of the calyx; by the azygous area and eighteen arms. There is no species with which it is necessary to make any comparison.

Found in Keokuk Group, in Washington county, Indiana, and now in the collection of Wm. F. E. Gurley.

ACTINOCRINUS BOTRUOSUS, n. sp.

Plate 2, Fig. 1, azygous side; Fig. 2, opposite side of the same specimen.

Species robust, above medium size. Calyx nearly as long as wide. Radial series prominent and inter-radial areas depressed so as to give it an obpyramidal form or sub-pentagonal outline to a transverse section. Plates thick, tumid, and each one bears a central node, which, on the larger plates, is elongated transversely. The rays are abruptly expanded above the third primary radials, leaving the inter-radial areas depressed, thus forming projecting clusters of each of the five radial series and directing the ambulacral openings nearly horizontally. The sutures are interrupted by radiating sculptures, that are so short that the sutures appear as if pitted.

Basals a little wider than high, very thick, contracted in the middle and at the upper part so as to leave an expanded rim projecting much beyond and below the point of attachment with the column and having widely gaping sutures below so that the calyx will stand on the projecting and contracted ends of the basal plates. Column round, radiately furrowed, and having a diameter a little more than one-third the greatest diameter of the expanded basals. First primary radials large, rather longer than wide, three hexagonal and two heptagonal. Second primary radials wider than high, hexagonal, and more than half as large as the first. Third primary radials as large as the second, heptagonal, and supporting upon each of the superior sides a single secondary radial which is axillary, and supports upon each of its superior sides two tertiary radials, the last of which is axillary and supports the free arms, in all the rays that are preserved to show that extent of development in our specimen, though some of the rays do not preserve the first arm plates. If the arms are alike, therefore, in these four rays there are eight to each one. In the ray opposite the azygous area, on one side of the third primary radial, there is a single secondary plate, which is axillary and supports on each upper side two tertiary radials, and on the other side there are three secondary radials, beyond which our specimen is not preserved. If the last secondary and tertiary radials are axillary, there are six arms in this series. By this arrangement, if the arms are uniform, there are thirty-eight arms to this species. But, we cannot be certain that all the arms are double, as we know in some instances in other species such is not the case. The greater probability is, however, that they are uniform and that the species possesses thirty-eight arms. The ambulacral openings come together on the first tertiary radial, and hence, if the projecting radial series were broken away, at this place, there would appear to be only nineteen ambulacral openings to the vault. There are no inter-secondary or inter-tertiary radials.

The first regular interradial is smaller than a second primary radial. It is followed by two smaller plates in the second range, and these by three smaller plates in the third range, which separate the lower part of the first secondary radials. Above this point there is some difference in the areas, and the plates are small and thrown out of any definite arrangement by being continued up the sides of the projecting arm series as well as covering the depressed interradial area and graduating into the plates of the vault without any line separating the plates of the calyx from those of the vault. In one of the areas there are in the fourth irregular range four plates and in another area there are five, these separate the first tertiary radials. The first plate in the azyzons area is smaller than a first primary radial and in line with them. It is followed by two plates, in the second range, each of which is nearly as large as a first regular interradial, and these are followed by a range of three plates which are somewhat smaller and separate the third primary radials. There are four plates in the fourth range and above this range the plates, in our specimen, are covered with the matrix so as to obscure the sutures, but the area above this does not seem to be different from the regular areas.

The vault is convex and covered with large polygonal plates over the ambulacral areas, each one of which is possessed of a large ventricose central node, while the interradial areas are abruptly sunken and covered with small plane plates. The proboscis appears to have been quite small and central though broken away from our specimen. The ventricose vault plates in this species are much like they are in *Actinocrinus monticuliferus* and the swelling may be due more or less to silicification.

about the same size. It is followed by three large plates and above these there are either one or two plates, that extend to the top of the calyx and connect with the plates of the vault.

This species is distinguished by its general form, depressed interradial areas, lobed extention at the arm bases, by the plates of the azygous and regular areas, and otherwise. It is a typical *Eretmocrinus* and the question now arises whether or not it can be distinguished from *Batocrinus*. The expanded basal plates is certainly not a generic character in *Actinocrinus* or *Batocrinus*, it is not peculiar to *Eretmocrinus*. Can it be, that taken in connection with the coarse and expanded arms, it becomes of generic value? We think not. The column is larger than is usual in *Batocrinus*, but that is certainly not a generic character. The form of the calyx and arrangement of the plates is the same as in *Batocrinus*. The only distinguishing difference left between *Eretmocrinus* and *Batocrinus* is to be found in the expansion of the arms. We believe that, in no instance, can this be of generic importance and, therefore, think that *Eretmocrinus* is separated from *Bactocrinus* by specific differences only. A mere combination of specific differences, which, if applied to its full extent, to *Batocrinus*, would subdivide the genus into many genera. We have, however, retained the name *Eretmocrinus*, from deference to the opinion of others, and provisionally, because it may be a convenient division of *Batocrinus*.

Found in the Keokuk Group, at Crawfordsville, Indiana, and now in the collection of Wm. F. E. Gurley.

AGARICOCRINUS PROFUNDUS, n. sp.

Plate 3, Fig. 1, basal view; Fig. 2, summit view; Fig. 3, azygous view of a smaller specimen.

Species large and preserving all the characters ascribed to it in numerous specimens. Calyx deep, hemispherical, outline subpentagonal. Plates within the concavity below the third radials, plane and smooth, and those from the third radials outward very tumid. The abrupt change from plane to tumid plates forms a rim within the concavity.

Basals small and entirely hidden by the column. First primary radials large, length about equaling the greatest width, a small part abruptly bent into the columnar concavity, three hexagonal two heptagonal. Second primary radials large and nearly square. Third primary radials larger than the second and about as large as the first, very tumid, pentagonal, axillary, and in three of the seem to belong to the radial series, and hence there is doubt about the area. The first plate is in line with the first primary radials and of about the same size. It is followed in the second range by three large plates, and these, in the third range, by three smaller plates, and above these there are two still smaller plates that belong to this area.

This species is so different from any other that has been described, in the part preserved, that no comparison with any of them will throw any light upon it.

Found in the Niagara Group at St. Paul, Indiana, and now in the collection of Wm. F. E. Gurley.

ERETMOCRINUS COMMENDABILIS, n. sp.

Plate II, Fig. 15, a specimen showing part of calyx, arms and column, azygous area on the right.

Species large. Calyx twice as wide as high, depressed in the interradial areas and somewhat lobed in the superior part, broadly truncated below. Plates moderately convex and granular, sutures distict and more or less beveled. Column large and composed of thick plates that are beveled externally, and alternately project one beveled edge beyond the other. Columnar canal large and nearly round. Basals short, truncated below and expanded to a thin edge, irregularly hexagonal, in outline, and having a width twice the diameter of the column. First primary radials a little wider than high, three hexagonal and two heptagonal. Second primary radials short, more than twice as wide as high, quadrangular. Third primary radials a little larger than the second, pentagonal, axillary, and support on each superior sloping side two secondary radials. The secondary radials are larger than the second and third primary radials, the second one is axillary and supports on each superior sloping side two tertiary radials. This arrangement gives to the species twenty arms. This is upon the assumption that the arm opposite the azygous area is like the three that are shown in the specimen, it being possible that it has only two arms. There are three single short plates in the commencement of each arm, these are followed by a double series of interlocking plates that are deeper than wide but which gradually widen, until at the distance of an inch and three-quarters from the calyx an arm is three times as wide as deep.

In the only regular area shown in our specimen there are two plates, one quite large followed by another half its size. The first azygous plate is in line with the first primary radials and of about the same size. It is followed by three large plates and above these there are either one or two plates, that extend to the top of the calyx and connect with the plates of the vault.

This species is distinguished by its general form, depressed interradial areas, lobed extention at the arm bases, by the plates of the azygous and regular areas, and otherwise. It is a typical *Eretmocrinus* and the question now arises whether or not it can be distinguished from *Batocrinus*. The expanded basal plates is certainly not a generic character in *Actinocrinus* or *Batocrinus*, it is not peculiar to *Eretmocrinus*. Can it be, that taken in connection with the coarse and expanded arms, it becomes of generic value? We think not. The column is larger than is usual in *Batocrinus*, but that is certainly not a generic character. The form of the calyx and arrangement of the plates is the same as in *Batocrinus*. The only distinguishing difference left between *Eretmocrinus* and *Batocrinus* is to be found in the expansion of the arms. We believe that, in no instance, can this be of generic importance and, therefore, think that *Eretmocrinus* is separated from *Bactocrinus* by specific differences only. A mere combination of specific differences, which, if applied to its full extent, to *Batocrinus*, would subdivide the genus into many genera. We have, however, retained the name *Eretmocrinus*, from deference to the opinion of others, and provisionally, because it may be a convenient division of *Batocrinus*.

Found in the Keokuk Group, at Crawfordsville, Indiana, and now in the collection of Wm. F. E. Gurley.

AGARICOCRINUS PROFUNDUS, n. sp.

Plate 3, Fig. 1, basal view: Fig. 2, summit view; Fig. 3, azygous view of a smaller specimen.

Species large and preserving all the characters ascribed to it in numerous specimens. Calyx deep, hemispherical, outline subpentagonal. Plates within the concavity below the third radials, plane and smooth, and those from the third radials outward very tumid. The abrupt change from plane to tumid plates forms a rim within the concavity.

Basals small and entirely hidden by the column. First primary radials large, length about equaling the greatest width, a small part abruptly bent into the columnar concavity, three hexagonal two heptagonal. Second primary radials large and nearly square. Third primary radials larger than the second and about as large as the first, very tumid, pentagonal, axillary, and in three of the rays support on each upper sloping side three secondary radials, which gives to each of these rays two arms. In each ray adjoining the azygous area there is on each superior sloping side of the third primary radial a single secondary radial, which is axillary and supports on each side three tertiary radials, which gives to each of these rays four arms. There are, therefore, fourteen arms in this species. The calyx is much more protuberant at the ends of the radial series adjoining the azygous area than elsewhere, by reason of the increased number of radial plates. The arms are composed of a double series of short plates, from the commencement united by the usual zigzag suture.

There is a single long twelve sided plate in each regular interradial area. It rests between the superior sloping sides of the first primary radials, where it is concave, to conform with the other plates adjoining. It then curves over the summit of the calyx, where it is very tumid and separates the primary, secondary and tertiary radials and unites with two plates belonging to the vault. There are four plates in the azygous area. The first one is in line with the first primary radials and slightly longer and narrower than either of them. It is followed by three plates, the middle one of which is narrow within the concavity of the calyx, but gradually expands as it curves over toward the vault and becomes wider than the lateral plates at its union with the three plates belonging to the vault. The lateral plates are wide within the concavity of the calyx and very tumid where they curve over toward the vault, but become narrow and flattened where they unite with the plates of the vault.

The vault is highly convex, and interradial areas concave. There is a large, tumid plate at the apex of this vault, which is surrounded by six large, convex plates and from two to four small plates in the azygous area. In some of our specimens there are only two of these plates at the top of the azygous area, that separate it from the summit plate, as shown in figure 2, and in others there are four, which is the case in the specimen illustrated by figure 3, but they are hidden from view, in the illustration, because of the prominence of the azygous swelling. A row of large tumid plates covers each ambulacral area from the summit to the arms and there are two of these plates at the base of the arms in each of the four armed series. It would seem that the ambulacral canals are covered with large plates where they unite in each radial series. The plates in the interradial areas are flattened or concave and more or less elongated. The azygous area is very wide and bears an elongated, more or less elliptical, bulbous promiportionally higher and the vault proportionally lower and so on, but the species are so different from each other that they never, even in fragments, can be mistaken for each other, and no light would be thrown upon them by pursuing the comparison. And so it will be found by comparing it with any other defined species.

Found by Prof. A. G. Wetherby, in the Keokuk Group, in Brown county, Kentucky, and now in the collection of Wm. F. E. Gurley.

AGARICOCRINUS ARCULA, n. sp.

Plate III, Fig. 7, basal view of a large specimen; Fig. 8, summit view of a small specimen; azygous view of the same.

Species medium size and preserving all the characters ascribed to it, in numerous specimens. Calyx deep, subconical; outline, subpentagonal. All of the plates of the calyx are flattened or concave, and conform to the outline of the calyx, none of them are convex.

Basals small, entirely hidden bv the column, that is, they form a little cup which is filled by the column, while the first primary radials rest upon the top of the cup. First primary radials rather longer than wide, a small part abruptly bent into the columnar concavity, three hexagonal, two heptagonal. Second primary radials somewhat irregular in outline, quadrangular, and fully as long as wide. Third primary radials larger than either the first or second, three hexagonal, two pentagonal, axillary, and support on each superior sloping side two secondary radials, which gives to this species ten arms. The arms are composed of a double series of short plates, from the commencement, united by the usual zigzag suture.

There are three plates in each regular interradial area. The first is an elongated octagonal plate that rests between the superior sloping sides of the first primary radials and separates the second and third primary radials and is followed by two narrow elongated plates that separate, in part, the third primary radials, and both secondary radials and unite with two plates belonging to the vault. There are seven plates, in the azygous area. The first one is in line with the first primary radials, but somewhat longer and narrower. It is followed by three plates, that separate the primary and first secondary plates, and are of nearly the same size. The third range consists of three plates, the middle one of which is the widest, that separate the second secondary radials and unite with the plates of the vault.

The vault is subpyramidal and flattened in the interradial areas. There is a large tumid plate, at the apex of the vault, which is surrounded by six large convex plates and three small plates, at the top of the azygous area. There is a single large tumid plate over the lower part of each ambulacral area. These large plates cover the ambulacral canals, where they unite, in each radial series. All other plates in the vault are smaller than those described, polygonal, vary much in size, some are convex but they are generally flat. The azygous area is covered with numerous small plates, is longitudinally convex centrally and has an azygous opening in the superior part of the central elevation.

This species is distinguished from all others heretofore described by the number and form of the regular interradials, by the number and form of the azygous plates and by having ten arms. Other differences are conspicuous when it is compared with other ten-armed species.

Found by Prof. A. G. Wetherby, in the Keokuk Group, in Tennessee, and now in the collection of Wm. F. E. Gurley.

CYLICOCRINUS (?) INDIANENSIS, n. sp.

Plate IV, Fig. 20, basal view; Fig. 21, azygous side; Fig. 22, opposite view.

There is doubt about the generic reference of this species, but, notwithstanding the wide variation from the type species, in the absence of a knowledge of the vault, we have concluded so to refer it, rather than to coin a new generic name. The calyx is broadly rounded below and slightly constricted toward the top, though somewhat semi-elliptical, in outline. Width about one and a half times the height. Plates convex and more or less nodose. Column small and round.

Basals three, equal, and forming an hexagonal disc having three re-entering angles and having a width from three to four times the diameter of the column. Each basal plate bears two spines that are directed downward around the column, and, upon the apices of which, the calyx will stand. The first primary radials are very large, a little wider than high, three hexagonal, two heptagonal. Second primary radials quadrangular and more than twice as wide as high. Third primary radials about the same size as the second, pentagonal, axillary and support on each upper sloping side the secondary radials. Our specimen preserves only one secondary radial in each series, but, as it does not show an ambulacral notch, it is believed there are two and that the second portionally higher and the vault proportionally lower and so on, but the species are so different from each other that they never, even in fragments, can be mistaken for each other, and no light would be thrown upon them by pursuing the comparison. And so it will be found by comparing it with any other defined species.

Found by Prof. A. G. Wetherby, in the Keokuk Group, in Brown county, Kentucky, and now in the collection of Wm. F. E. Gurley.

AGARICOCRINUS ARCULA, n. sp.

Plate III, Fig. 7, basal view of a large specimen; Fig. 8, summit view of a small specimen; azygous view of the same.

Species medium size and preserving all the characters ascribed to it, in numerous specimens. Calyx deep, subconical; outline, subpentagonal. All of the plates of the calyx are flattened or concave, and conform to the outline of the calyx, none of them are convex.

Basals small, entirely hidden bv the column, that is, they form a little cup which is filled by the column, while the first primary radials rest upon the top of the cup. First primary radials rather longer than wide, a small part abruptly bent into the columnar concavity, three hexagonal, two heptagonal. Second primary radials somewhat irregular in outline, quadrangular, and fully as long as wide. Third primary radials larger than either the first or second, three hexagonai, two pentagonal, axillary, and support on each superior sloping side two secondary radials, which gives to this species ten arms. The arms are composed of a double series of short plates, from the commencement, united by the usual zigzag suture.

There are three plates in each regular interradial area. The first is an elongated octagonal plate that rests between the superior sloping sides of the first primary radials and separates the second and third primary radials and is followed by two narrow elongated plates that separate, in part, the third primary radials, and both secondary radials and unite with two plates belonging to the vault. There are seven plates, in the azygous area. The first one is in line with the first primary radials, but somewhat longer and narrower. It is followed by three plates, that separate the primary and first secondary plates, and are of nearly the same size. The third range consists of three plates, the middle one of which is the widest, that separate the second secondary radials and unite with the plates of the vault.

The vault is subpyramidal and flattened in the interradial areas. There is a large tumid plate, at the apex of the vault, which is surrounded by six large convex plates and three small plates, at the top of the azygous area. There is a single large tumid plate over the lower part of each ambulacral area. These large plates cover the ambulacral canals, where they unite, in each radial series. All other plates in the vault are smaller than those described, polygonal, vary much in size, some are convex but they are generally flat. The azygous area is covered with numerous small plates, is longitudinally convex centrally and has an azygous opening in the superior part of the central elevation.

This species is distinguished from all others heretofore described by the number and form of the regular interradials, by the number and form of the azygous plates and by having ten arms. Other differences are conspicuous when it is compared with other ten-armed species.

Found by Prof. A. G. Wetherby, in the Keokuk Group, in Tennessee, and now in the collection of Wm. F. E. Gurley.

CYLICOCRINUS (?) INDIANENSIS, n. sp.

Plate IV, Fig. 20, basal view; Fig. 21, azygous side; Fig. 22, opposite view.

There is doubt about the generic reference of this species, but, notwithstanding the wide variation from the type species, in the absence of a knowledge of the vault, we have concluded so to refer it, rather than to coin a new generic name. The calyx is broadly rounded below and slightly constricted toward the top, though somewhat semi-elliptical, in outline. Width about one and a half times the height. Plates convex and more or less nodose. Column small and round.

Basals three, equal, and forming an hexagonal disc having three re-entering angles and having a width from three to four times the diameter of the column. Each basal plate bears two spines that are directed downward around the column, and, upon the apices of which, the calyx will stand. The first primary radials are very large, a little wider than high, three hexagonal, two heptagonal. Second primary radials quadrangular and more than twice as wide as high. Third primary radials about the same size as the second, pentagonal, axillary and support on each upper sloping side the secondary radials. Our specimen preserves only one secondary radial in each series, but, as it does not show an ambulacral notch, it is believed there are two and that the second one bears the free arms. Evidently there were only ten arms in this species.

There are three plates in each regular interradial area, one large plate followed by two small ones that are bent inward and evidently unite with the plates of the vault, though none of the vault is preserved in our specimen. The first plate is larger than the second and third primary radials together, but only about two-thirds as large as a first primary radial. The first azygous plate is in line with the first primary radials, and slightly longer and narrower. It is followed by three plates in the second range and four in the third range, beyond which our specimen is not preserved.

Found in the Niagara Group, at St. Paul, Indiana, and now in the collection of Wm. F. E. Gurley.

FAMILY PLATYCRINIDÆ.

PLATYCRINUS VASCELLUM, n. sp.

Plate II, Fig. 16, basal view; Fig. 17, azygous side view; Fig. 18, summit view of the same specimen.

Species medium size. Calyx broadly rounded below, somewhat half globular in form and about twice as wide as high. Surface covered with nodes. Sutures beveled. Column small.

The basals form a pentagonal disc, having a width equal to about three times the diameter of the column. The cicatrix for the attachment of the column slightly concave. The small basal bears three nodes and the larger basals four or five each, as they are, in part, broken, as shown in figure 16, it is not clear whether they had four or five. The calyx will stand on the points of these nodes. First radials slightly wider than high, expand upward, moderately convex toward the articulating scar, three heptagonal, two hexagonal. The articulating scar for the second radial is a little more than one-third of the width of the plate, from each side of which the plate slopes to the suture. Each plate is ornamented with nine nodes arranged as follows: Two lines of three nodes each radiate from below the middle part of the second radial to the inferior lateral angles of the plate, one node is in the middle of the lower part of the plate, and there is one near each of the superior lateral angles of the plate. The second radial is very thin, triangular, directed horizontally, axillary and supports upon its outer sloping sides the free arms. There are, therefore, ten arms in this species. The arms are small and the first plates are directed horizontally.

Interradials large, convex and each one bears a central node. Vault slightly convex and covered with rather large, polygonal, convex plates, each one of which bears a central node. The azygous orifice is submarginal, surrounded by seven plates, the larger one of which stands nearly upright on the edge of the azygous interradial.

This species is distinguished by the surface ornamentation, large, convex, nodose inter-radials, and position and character of the azygous orifice, and small, horizontally directed second radials, and ten arms.

Found by Prof. A. G. Wetherby, in the Keokuk Group, in Tennessee, and now in the collection of Wm. F. E. Gurley.

MACROSTYLOCRINUS INDIANENSIS, n. sp.

Plate III., Fig. 23, side view.

Calyx semi-elliptical in outline. Sutures beveled. Surface sculptured in longitudinal and transverse lines, depending on the shape of the plate, but not radiately sculptured from a central point on any of the plates.

Basals three, one about half the size of either of the others, and together forming a little cup, that bears a very small cicatrix at the base for the attachment of a very small column. First radials large, about as wide as high, three heptagonal and two hexagonal. Second radials very small, short, quadrangular, about three times as wide as high. Second and third radials together about half as large as the first. Third radials about the same size as the second, pentagonal, axillary, and bearing upon each upper sloping side a single secondary radial. We have three specimens belonging to this species and none of them have more than a single secondary radial and that appears to have supported an arm, though no part of an arm is preserved on either of the specimens, neither is any part of the vault. The species evidently possessed only ten arms.

The first inter-radial is a narrow, elongated plate, resting between the lateral sides of the first radials and extending as high as the third radial. It is presumed that it was followed by two small plates, but they are not preserved in either of our specimens.

This species is so different from all the species heretofore described that even a fragment of it can be distinguished, and no comparison, therefore, with either of them is necessary.

Found in the Niagara Group, at St. Paul, Indiana, and now in the collection of Wm. F. E. Gurley.

FAMILY RHODOCRINIDÆ.

ARCHÆOCRINUS KNOXENSIS, n. sp.

Plate III, Fig. 10, basal view; Fig. 11, azygous view; Fig. 12, summit view, the matrix covers the sutures of some of the plates.

Species rather large. Calyx bowl-shaped, subpentagonal in outline, about one-half wider than high. Radial ridges not defined. Plates highly convex and each one bearing a central node and some of the largest plates bearing two or three nodes. Sutures beveled. Surface granular. Columnar cavity rather small and subpentagonal in outline.

Basals small and hidden by the column. They form a small cup which is filled with the end of the column, and on the top of which the subradials rest. Subradials large, longer than wide, abruptly bent into the columnar cavity and upward between the under sloping sides of the first radials. The azygous subradial is octagonal, the others heptagonal, by reason of three plates in the azygous area touching the subradial, while only two touch it in the other areas. The summit is not truncated in the regular areas and only minutely in the azygous area. The first primary radials are smaller than the subradials, about as high as wide; each one is heptagonal. The inferior angle is sunk in a pit formed by it and the adjacent lateral angles of the subradials. Second primary radials more than half as large as the first, three heptagonal and two hexagonal, each one wider than long. Third primary radials very small, of unequal size, generally about one-third as large as the second primary radials, one hexagonal, the others pentagonal, axillary, and support on each upper sloping side two small secondary radials. There are, therefore, ten arms in this species and ten ambulacral openings to the vault. There are no intersecondary radials.

In each regular interradial area there is a large central plate, which is surrounded in some areas by seven plates, and, in other areas, by eight plates, and above these there are three or four plates that may be said to belong to the calyx, but they graduate into the plates of the vault without any distinct line of separation. In fact, the area is continuous with the vault. The azygous interradius differs from the other areas only in being a little wider and containing a few more plates. The central plate is somewhat larger than in the other areas and slightly truncates the subradial, and is surrounded with eight other small plates. On each superior lateral side of the ring thus formed by the eight plates, there are four plates, and above these there or three or four plates that may be said to belong to the calyx, but they graduate into the plates of the vault without any line of separation.

The vault is moderately convex over the ambulacral canals and slightly depressed in the interradial areas. It is covered with rather large polygonal plates, each of which bears a central node. Part of the matrix is on the summit of our specimen so as to present the delineation of all the plates, as may be seen in the illustrations. There is a small subcentral proboscis.

This species is distinguished by its interradial areas alone from all other described species. Indeed, it is quite peculiar in many respects, and no comparison is necessary with any that has been described.

Found by Prof. A. G. Wetherby, in the Trenton Group, in Knox county, Tennessee, and now in the collection of Wm. F. E. Gurley.

GILBERTSOCRINUS GREENEI, n. sp.

Plate III, Fig. 13, basal view; Fig. 14, side view; Fig. 15, summit of the same specimen, part of the vault is broken away and two pieces are chipped from the base.

Calyx broadly truncated at the base and summit, subpentagonal in transverse section, constricted below the arms, height and width subequal. Radial ridges rounded. Spines on the first radials directed downward at an angle of forty-five degrees, and base depressed so the calyx will rest on the points of these spines. The first interradials are also spine-bearing and all other plates slightly convex. Column round and pierced by a cinque foil canal.

Basal plates depressed, anchylosed and form a pentagonal disc about two and a half times as wide as the diameter of the column. Subradials a little the largest plates in the calyx, hexagonal, without reference to any division of the basal disc, length and width nearly the same, almost wholly within the basal concavity, not visible in a side view. First radials slightly smaller than the subradials, heptagonal, a little wider than long, rest on the outer rim of the truncated base of the calyx, and each one bears a short central spine, which, by reason of the position of the plate, is directed downward at an angle of about forty-five degrees. Second primary radial smaller than the first, longer than wide, hexagonal, inferior lateral sides the longest, most convex in the central part. Third primary radials very little smaller than the second and a little less convex, length and width subequal, part of them heptagonal, others hexagonal, and support on each superior sloping side two secondary radials, and in one ray shown in our specimen there are three secondary radials. The secondary radials are subequal in size and somewhat smaller than the third primary radials. The last secondary radials bear the cicatrix for the support of the arms, at the top of which there is an ambulacral orifice. There are, therefore, ten arms and ten ambulacral openings to the vault in this species.

There are three intersecondary plates in each area, one followed by two, which unite with the plates of the vault, without any distinct line of separation. These two plates, at their inferior ends, separate the superior ends of the second secondary radials, and their superior ends separate the ambulacral orifices, and interlock with the plates of the vault.

There are only two regular interradial areas completely preserved in our specimen and each of these contains thirteen plates. The first plate is a little smaller than a first primary radial, hexagonal, rather wider than long, broadly truncates a subradial, bears a short central spine, and is followed by three plates in the second range. There are also three plates in the third range and above these there are three ranges of two plates each, the last two of which are surmounted with two plates belonging to the under side of the so-called pseudo-brachial appendages.

The vault is nearly flat, gently convex over the ambulacral areas and slightly depressed, in the interradial areas, until the depression is cut short by the so-called pseudo-ambulacral appendages. The vault is covered with small polygonal plates. The azygous opening is not preserved in our specimen. The words "pseudo-ambulacral appendages" are quite erroneous, when applied to this species or to the genus to which it properly belongs. If we now turn our attention to the vault, which is well shown in the illustration, we see the ambulacral areas, the ambulacral openings, and the plates in the intersecondary areas connecting with the vault, as the same parts may be seen in other genera. The depressions in the interradial areas are the same. In other genera we have two orifices and sometimes four, six, or eight penetrating the vault between the arms, which have been supposed by some to be ovarian apertures, and this view is supported by the established fact from numerous observations, that they are excurrent orifices. They are the same in the species under consideration, the difference being, that in this species, small plates covering these "ovarian apertures" are continued so as to cut off the interradial depressions, and present the ends of the canals upon the outer edge or beyond the outer edge of the plates of the calyx, while in other genera and species the "ovarian apertures" are confined to the plates of the vault, and open gutters lead from them across the plates to the outer margin of the plates of the calyx. The structure of these orifices we have fully defined in various species of *Dolatocrinus* and *Batocrinus*, and very clearly they are not "pseudo-ambulacral appendages" in those genera, and for the same reason, we think, they are not in the species before us.

This species is congeneric with the species first described by Hall as *Trematocrinus spinigerus* and subsequently referred by him to *Gilbertsocrinus*, and later referred to *Gilbertsocrinus* by Whitfield. It is not a *Goniasteroidocrinus*, and if belonging to any defined genus, it is to *Gilbertsocrinus*. We have no specimens belonging to the type of *Gilbertsocrinus* for comparison, and the definitions and illustrations by English authors are very obscure and unsatisfactory. It is very plain, however, that *Gilbertsocrinus* and *Goniasteroidocrinus* are distinct genera, and that our species is nearer *Gilbertsocrinus* than *Goniasteroidocrinus*. It is quite probable that *Gilbertsocrinus* is confined to the subcarboniferous rocks of Europe, and is not an American genus, and that *Gilbertsocrinus spinigerus* and the two species described in this Bulletin belong to an undefined Devonian genus. We are not willing, however, to propose a new generic name until some author shall properly define *Gilbertsocrinus* or until we may have an opportunity to examine a specimen belonging to the type species in order to be assured that two genera are, in fact, included under one name. We use the name *Gilbertsocrinus*, therefore, provisionally.

This species, when compared with *G. spinigerus*, differs, in having two plates in the second intersecondary range instead of one, in having two plates in each of the three superior ranges in the regular interradial areas instead of only one in part of them, in the form of the third primary radials, in having a spine on the first interradial plate, and in other peculiarities that distinguish species.

Found in the Hamilton Group near Charleston, Indiana, and now in the collection of Wm. F. E. Gurley. The specific name is in honor of its discoverer, Prof. G. K. Greene, the well known collector at New Albany, Indiana.

GILBERTSOCRINUS INDIANENSIS, n. sp.

Plate III, Fig. 16, basal view of a specimen preserving some complete spines; Fig. 17, basal view of another specimen; Figs. 18 and 19, lateral views of same; Fig. 20, basal view of a small specimen probably belonging to the same species; Fig. 21, summit view of same; Fig. 22, lateral view of the same specimen with interradial plates anchylosed.

Calyx truncated at the base and summit, subpentagonal, in transverse section, broadly constricted below the arms, height and width subequal. Radial ridges angular. Very long spines on the first and second radials and also on the first interradials. Basal cavity broad and deep. Column round and pierced by a cinquefoil canal. When compared with *Gilbertsocrinus greenei*, in the above particulars, it will be found to have more angular radial ridges, longer spines, deeper basal concavity, and spines on the second radials that do not exist in that species. In the latter respect it agrees with *Gilbertsocrinus spinigerus*, but not in the other respects.

Basal plates very much depressed, anchylosed, and form a pentagonal disc, less than twice as wide as the diameter of the column. Subradials, the largest plates in the calyx, hexagonal, longer than wide, almost wholly within the basal concavity, and not visible in a side view. First radials rather smaller than the subradials, heptagonal, about as wide as long, rest on the outer rim of the truncated base of the calyx, and each one bears a long, slender, central spine, which, by reason of the position of the plate, is directed downward, at an angle of from thirty to forty-five degrees, and on the points of which the calyx may be made to stand. Second primary radials smaller than the first, longer than wide, hexagonal, inferior lateral the longest and each one bears a long central spine directed horizontally. Third primary radials less than half the size of the second, and longer than wide. This is as far as the plates are preserved in the two larger specimens, which we have illustrated, and that far they seem to agree with the smaller specimen. The interradial areas to this height appear to agree substantially with *G. greenei.* Two of the interradial areas are like the one represented in Figure 18 and three of them are like the one represented in Figure 19. From this point to the summit we will look at the small specimen and note how it differs from *G. greenei.* The plates in the intersecondary and interradial areas are anchylosed, but the intersecondary areas are proportionally longer and the interradial areas shorter, and hence, it would appear, that there are more plates in the intersecondary areas in this species than in *G. greenei,* but this is estimating on space, and if we could see the plates, their size might govern instead of space.

The vault, however, is quite different in this species from what it is in *G. greenei.* The vault is covered, in this species, by minute, almost granular convex plates, which gives it quite a different aspect. Although the specimen is much smaller, the plates are at least fifty per cent. more numerous, in this species than in that. The interradial areas are much more depressed and the ovarian canals (if it be proper to call them by that name) project much farther beyond the margin of the calyx, in this species than they do in *G. greenei,* and they are proportionally larger, and occupy more space between the ambulacral openings. The vault of our specimen preserves part of the azygous apertures which is located on an ovate elevation. The vault of this species is altogether different from that in *Gilbertsocrinus spinigerus* so that no comparison with it is necessary.

Found in the Hamilton group, at Charleston, Indiana, and now in the collection of Wm. F. E. Gurley.

FAMILY TAXOCRINIDÆ.

ONYCHOCRINUS PULASKIENSIS, n. sp.

Plate IV, Fig. 1, view opposite the azygous side, with four and one-third inches of the column; Fig. 2, azygous side of the same specimen without the column, the specimen is compressed antero-posteriorly which makes the head appear too wide.

Species large and robust. Calyx very low, saucer-shaped. Plates finely granular. Sutures distinct. Column very large and within sixth-tenths of an inch of the calyx, tapering and composed of very thin plates, but below that composed of thick plates, some thicker than others and projecting beyond them, but not regularly alternating at all times, though becoming more regular in this respect an inch or two below the calyx. It is somewhat elliptical and pierced by a long-rayed stellate canal.

Basals covered by the column. Subradials very short and superior angles obtuse. Primary radials four in each ray and differing but little in size, the first and fourth are the longer and subequal. Each one is wider than high and the third one is nearly twice as wide as high. The sutures are transverse. The fourth plate in each ray is axillary and supports the second series of radials, the plates of which are very long, quite as long as those in the first series, excepting the first and fourth. In one of the rays of our specimen, seven of the plates are preserved as shown in figure 1, and a small armlet is thrown off from the fifth plate.

One interradial is preserved in three of the areas, and there may not have been any more, except in the azygous area, where there were evidently several small plates, in addition to the one preserved.

There is no described species for which this one might be mistaken and hence there is no necessity for drawing comparisons.

Found by Prof. A. G. Wetherby in the Kaskaskia Group, in Pulaski county, Kentucky, and now in the collection of Wm. F. E. Gurley.

TAXOCRINUS WETHERBYI, n. sp.

Plate IV, Fig. 3, basal view, azygous side down; Fig. 4, view opposite the azygous side; Fig. 5, summit view of same specimen, having the ends of the arms obscured by the matrix.

This species is founded upon two specimens presenting the same general characters, shown by the illustrations, and while the first impression may be, that they are compressed longitudinally, yet a close examination does not reveal any displaced plates, and the rugular infolding of the arms leads to the conclusion, that they are very little, if any, out of their normal condition. That being true, the calyx is very short and broadly expanded. The radial ridges are rounded and the interradial areas flattened or depressed, giving a pentagonal outline to the calyx as seen from below, but a rounded outline when the infolded arms are seen from above. The surface of the plates is finely granular and the sutures are distinct.

Basals covered by the column. Subradials very short and superior angles obtuse. Primary radials four, in each ray, broadly rounded and differing very little in size. The sutures are transverse without any overlapping. The fourth plate in each ray is axillary and supports upon each superior sloping side two secondary radials. The secondary radials are only a little smaller than the primary. The second secondary radials are axillary and the proximal sides, in each radial series, support two tertiary radials, the last of which are axillary and support a quaternary series of plates above which rays again divide, the distal sides support four tertiary radials the last of which are axillary and above which the radial rays again divide. The above method of division is without variation, in the specimen, illustrated, except in one instance, where a third tertiary radial is axillary instead of the second plate. In the other specimen there are more bifurcations on the third tertiary radial in the distal series than there are on the fourth. If there are any more divisions than those mentioned, they are covered by the matrix. By the divisions above mentioned there are fourteen arms to each ray or seventy arms in the species, and the differences in the rays commence in the tertiary radials, above which, radial differences are not of specific importance.

The plates, in the regular interradial areas, are of almost uniform size. In the best preserved areas there is one plate in the first range, two in the second, three in the third and four in the fourth, but in one of the areas there are only three plates, in the fourth range. The fourth range curves in toward the vault and it would seem, therefore, to be the last range properly belonging to the calyx. There is one plate in each intersecondary radial area, which will necessarily give the vault a pentagonal outline, notwithstanding its rounded appearance when we look at the infolded arms. The only plates preserved in the azygous area belong to the small column of hexagonal plates on one side of the area. An examination of the primary radial plates and appearance of the specimens lead to the conclusion that this area is depressed and quite different from the other areas in all respects.

This species is so different from all others that no comparison with any of them is necessary to distinguish it, beside it is the first time a species belonging to this genus has been described from rocks of the age of the Kaskaskia Group.

Found by Prof. A. G. Wetherby, in whose honor we have named the species, in the Kaskaskia Group, in Pulaski county, Kentucky, and now in the collection of Wm. F. E. Gurley.

EMPEROCRINUS, n. gen.

[Ety. *emperos*, deformed; *krinon*, lily.]

This genus is proposed to receive species that have three basals, five subradials and regular interradials, but do not belong to any of the described genera in the family *Taxocrinidæ*. Basals three, of unequal size. Subradials five, three heptagonal, two hexagonal. Primary radials two in each ray. Regular interradials one or more in each area. Azygous plates two or more. The radial system is altogether different from that belonging to any other genus, in the family Taxocrinidæ, but the whole structure is fundamentally different, in all other respects, from all other families of crinoids and hence the genus is placed here, at least, provisionally. Type *Emperocrinus indianensis*.

EMPEROCRINUS INDIANENSIS, n. sp.

Plate IV, Fig. 16, basal view; Fig. 17, azygous side view of the same specimen, the plates on the vault are covered with the matrix.

Calyx very low, saucer-shaped, truncated at the base or flattened over the basal and subradial area, subpentagonal in outline. Plates smooth or granular. Column round. Columnar canal cinque foil.

Basals consist of two plates of equal size and one much smaller; together they form a flat pentagonal disc, which is almost covered by the end of the column. Subradials are of about equal size, nearly as long as wide, three heptagonal, two hexagonal. First primary radials larger than the subradials, pentagonal, having two inferior sloping sides that rest between the sloping sides of the subradials, abutting laterally upon the interradials and being truncated entirely across the superior end. Second primary radials of almost exactly the same size as the first, but a little wider and turn the sloping sides in the opposite direction, pentagonal, axillary, and support on the superior sloping sides two secondary radials. This gives to the species ten arms and ten ambulacral openings to the vault. The arms are directed almost horizontally, but no part of them is preserved in our specimen.

There are three regular interradials in each area. The first one truncates a subradial and separates the first and second primary radials. It is followed by two plates that separate the first secondary radials and curve over and unite with the plates of the vault. The azygous area is wider than the regular areas and contains four plates. The first one is larger than a first regular interradial, truncates a subradial and separates the first and second primary radials. It is followed by three plates in the second range that unite with the plates of the vault.

The vault in our specimen is covered with the lime stone matrix, so that the plates cannot be distinguished.

Found in the Niagara Group at St. Paul, Indiana, and now in the collection of Wm. F. E. Gurley.

FAMILY PTEROTOCRINIDÆ.

PTEROTOCRINUS WETHERBYI, n. sp.

Plate IV, Fig. 6, azygous side of an almost perfect specimen except the interbrachial plates are broken off; Fig. 7, basal view of another specimen, azygous side down, and having the interbrachials broken: Fig. 8, summit view of the same showing the small plates at the apex of the vault; Fig. 9, view of another specimen with the arms broken off so as to show the furrowed vault and sides of interbrachials that are somewhat broken.

Species medium size. Calyx low, saucer-shaped, between two and three times as wide as high, broadly constricted in the region of the primary radials. Surface finely granular. Column small, round, deeply inserted and having a very minute central canal.

Basals two, each pentagonal, by reason of being slightly truncated, at one angle, by the azygous plate, and together, forming a low, subpentagonal cup, notched at one angle, by the azygous plate, and having a deep central depression for the insertion of the column, which has a diameter equal to about one-fourth the width of the basal pentagon. The columnar cavity is funnel-shaped and has a rather sharp or angular rim. First primary radials of unequal size and by reason of the truncation of two of them by the azygous plate very unlike in outline. They are from three to four times as wide as long, three heptagonal and two hexagonal. Second primary radials small triangular plates resting on the middle part of the straight upper face of the first radials and each occupying from one-fourth to one-fifth of the width of the superior face of a first radial and supporting on each sloping lateral side part of a first secondary radial. There is only a single secondary radial in each series and it is more than twice as wide as high, irregularly pentagonal, and rests its part upon the first primary radial but rarely if ever extends to the superior lateral angle of it, and bears upon the superior side a tertiary series and upon the superior lateral side part of another tertiary series of plates. Prof. Meek called the tertiary radials in this genus brachials, but we prefer to call them the tertiary radials, because they rest, in part, upon the first primary radials as well as upon the secondary radials and constitute part of the calyx. In some rays there are three tertiary radials entering into and forming part of the calyx and in other rays there are four, and these are followed by the free arms. In the series resting in part on the first primary radials there are usually four tertiary radials, and in the series resting upon the secondary radials there are three tertiary radials. The first four or five plates of the free arms are very short and transverse and above these the arms are composed of a double series of interlocking plates. Each plate bears a small pinnule. The arms gradually taper and are depressed, convex or somewhat flattened externally. There are twenty arms, four between interradials, and they infold at the top leaving the apex of the vault uncovered and the interradials extended above them.

The azygous plate is quadrangular, the shorter and lower lateral sides rest in a notch at the angle of the pentagon formed by the basal plates, while the longer convex sides truncate the inferior lateral angles of the two first primary radials. The interradials, or interbrachials, as they are usually called, consist of five plates which divide the arms into clusters of four each. They are leaf-like expansions, each of which rests in a broad, deep, angular furrow in the vault, and projects half its width beyond and above the arms, where it is thin and knife-like. The thicker part of each plate is within the outer margin of the infolded arms, and the shape of the furrow into which the interradial is inserted may be seen in figure 9, though a small piece of the interradial is remaining in the lower part of the furrow.

The vault is pyramidal and fluted or furrowed and covered with large plates. In the lower part of the vault the plates are sharply angular in the middle part and separated by a suture in the bottom of the furrows, but higher up there are two angular ridges on a plate, separated by a flattened space, at the bottom of the furrow, without a suture. This arrangement breaks the continuation of the sutures and of course strengthens the vault. The apex of the vault is small and covered with quite small plates. A *Platyceras* or other Gastropod could not attach to this summit on account of the projecting knife-like edges of the interradials.

This species is so different from all others that no comparison with any of them is necessary to distinguish it.

Found by Prof. A. G. Wetherby, in whose honor we have proposed the specific name, in the Kaskaskia Group, in Pulaski county, Kentucky, and now in the collection of Wm. F. E. Gurley.

FAMILY POTERIOCRINIDÆ.

POTERIOCRINUS VAGULUS, n. sp.

Plate 4, Fig. 10, azygous side on the left; Fig. 11, opposite view of same specimen.

Species medium size, robust, arms coarse, calyx obconoidal, truncated below, about as long as wide; sutures distinct; surface granular. Column large, tapering from the calyx, and composed of moderately thick plates. Columnar canal small.

Basals rather large, longer than wide and forming an obpyramidal cup. Superior angles obtuse. Subradials rather longer than wide, four hexagonal, one heptagonal. First radials wider than long and truncated the entire width above. Second radials shorter than the first and truncated the entire width above, at which point the five arms seem to have become free without the usual gaping sutures or other special provisions for a free movement. Above the second radials the arms continue without any apparent decrease in diameter to the first and probably the only bifurcation. This takes place on the eighth plate in the arm on the left of the azygous area, on the sixth plate in one of the lateral arms and in the arm opposite the azygous area the eighth plate is cuneiform, not axillary, and beyond this it is not preserved in our specimen. The other two arms are not preserved in our specimen as high as the place of bifurcation. Probably, the arm opposite the azygous area remains single and the two arms not preserved divide as in the first two above described. Two of the arms are preserved as high as the twelfth plate above the first bifurcation without any evidence of another division. It, therefore, appears that only four arms divide and that this species possesses five arms in the lower part and nine in the upper part. The arms are composed of short, cuneiform plates, and are round externally, showing three-fourths of the circumferance, which necessarily leaves the arm furrows very narrow.

The first azygous plate is large, longer than wide, hexagonal, truncates a subradial, and extends as high as the second radial. Beyond this neither the azygous area or the proboscis is preserved, in our specimen, but there are numerous scattering plates belonging to the proboscis which are transversely serrated.

This species is so different from all others that have been described that no comparison is necessary with any of them to distinguish it.

Found by Prof. A. G. Wetherby, in the Kaskaskia Group, in Pulaski county, Kentucky, and now in the collection of Wm. F. E. Gurley.

ZEACRINUS PULASKIENSIS, n. sp.

Plate 4, Fig. 12, azygous side; Fig. 13, opposite view.

Species below medium size, subcylindrical, constricted above the calyx, truncated below and slowly tapering at the superior end. Calyx very low, broadly truncated and depressed below. Surface smooth or finely granular. Column very small and round.

Basals deeply sunken so as to be hidden by the column. Subradials longer than wide, and curve into the basal concavity and upward at about the middle part, which is gently rounded, so as to show the superior ends in a side view. First radials about one and a half times as wide as high, pentagonal, truncated the entire width above, and separated from the second plates, which belong to the free arms by a gaping suture. Second plates or first arm plates longer than the first radials, nearly as high as wide, constricted in the middle part, and truncated the entire width above in a line more or less inclined for the support of the second arm plate, which is short and cuneiform. There are, therefore, only five arms in this species. The arms are robust, subfusiform and composed of a single series of short, cuneiform plates. The pinnules are short and strong.

The first azygous plate is much smaller than the second, and is embraced between a subradial and the first radial on the right, without extending to the second subradial as is usual in this genus. The second azygous plate is longer than wide, truncates a subradial and curves in toward the vault so as to extend very slightly beyond the single first radial on the left. The third azygous plate rests upon the first and curves in upon the vault at the top of the first radial. The fourth azygous plate truncates the second. What appears to be part of the top of the proboscis may be seen at the summit of our specimen, but it is too imperfect for description.

This small species is peculiar and so different from all heretofore described that the five arms alone will always identify it.

Found by Prof. A. G. Wetherby in the Kaskaskia Group, in Pulaski county, Kentucky, and now in the collection of Wm. F. E. Gurley.

ZEACRINUS DURABILIS, n. sp.

Plate 4, Fig. 14, azygous side; Fig. 15, opposite view.

This species is founded upon two specimens, in about an equal state of preservation, but the one illustrated is one-half larger than the other. The species is small and short, subovate in outline, being truncated at the base, subfusiform in the middle, and tapering toward the summit.

Calyx very low, rounded and depressed below. Plates convex; sutures distinct. Surface granular. Column small and round.

Basals sunken so as to be hidden by the column. Subradials longer than wide but hardly visible in a side view. First radials about one and a half times as wide as high, pentagonal, truncated the entire width above, and separated from the second radials by a gaping suture. Second radials longer and larger than the first, about one-half wider than high, rounded externally, pentagonal, and support upon each superior sloping side the secondary radials or free arms. In each ray adjoining the azygous area, there is a single, long, secondary plate, on the distal side of the second primary plate, that is axillary and supports an arm upon each superior side, while an arm arises directly from the proximal side of each second primary radial. This arrangement gives to each of these rays three arms. The lateral rays are constructed in the same way and each bears three arms. In the ray opposite the azygous area there are only two arms which are supported on the upper sloping sides of the second primary radial. The species, therefore, has fourteen arms. The arms are short, small, regularly taper, and are composed of small cuneiform plates. The pinnules are short.

The first azygous plate is narrow, elongated, pentagonal, rests between two subradials and the first radial on the right, and abuts upon the second and third interradials. The second azygous plate is larger than the first, hexagonal, truncates a subradial, and adjoins the first radial and part of the second radial on the left, and the first and third azygous plates on the right, and is truncated by the fourth azygous plate. The third azygous plate is shorter than the second, hexagonal, truncates the first azygous plate, and adjoins the first and second radials on the right, and the second and third azygous plates on the left, and supports the fifth azygous plate. The fourth azygous plate extends slightly above the second radial on the left, and the fifth azygous plate somewhat more above the second radial on the right, and the alternate arrangement of the plates continues until the area is lost in the proboscis.

This species is distinguished by its short ovate form and by having fourteen arms as well as by less important characters.

Found by Prof. A. G. Wetherby, in the Kaskaskia Group in Pulaski County, Kentucky, and now in the collection of Wm. F. E. Gurley.

BARYCRINUS WASHINGTONENSIS, n. sp.

Plate IV, Fig. 18, azygous side, there is one too many brachials in the ray on the left; Fig. 19, opposite view.

Species robust, medium size. Calyx higher upon the azygous side than upon the other, somewhat bowl-shaped, one-half wider than high on the azygous side, and nearly twice as wide as high on the opposite side. Plates thick, very tumid in the central part, and having a broadly rounded ridge extending to each adjoining plate, thus giving the calyx a radiately sculptured aspect without depressions at the angles of the plates.

Basal plates form a pentagonal disc nearly one-half wider than the diameter of the column, and show the radiating surface ridges even on the narrow area surrounding the column. Subradials large, somewhat unequal in size, about as wide as high, four hexagonal, one heptagonal. First radials of unequal size, much wider than high. Facets for the reception of the second radials concave, directed somewhat outward and not extending quite to the superior lateral angles. Second radials very thin and rounded externally. Third radials a little longer than the second, axillary, and support upon each upper sloping side strong arms. The second and third radials above described are usually called brachials. The ray on the left of figure 13 there shows thres brachials, but the artist mistook a slight displacement filled with stone for a plate, and there should have been only two brachials in the figure. There are, therefore, ten arms in this species, two from each ray. They are composed of long, rounded cuneiform plates that bear numerous armlets. In the lower part of the arms every third plate bears an armlet, but higher up every second or alternate plate bears an armlet. The armlets are composed of short plates and look like small arms.

First azygous plate is quadrangular, broadly truncated, a subradial separates two first radials and rapidly expands to the summit of the calyx. The other azygous plates, vault and proboscis are not preserved in our specimen.

This species is readily distinguished from *B. formosus* by the surface ornamentation and absence of pits at the angles of the plates, as well as by comparison of the specific details. It is still farther removed from *Barycrinus blairi* and *Barycrinus boonvillensis*, and need not be compared with any other described species, as there is none for which it might be mistaken.

Found in the Keokuk Group in Washington County, Indiana, and now in the collection of Wm. F. E. Gurley.

FAMILY DOLATOCRINIDÆ.

DOLATOCRINUS CORPOROSUS, n. sp.

Plate V, Fig. 1, basal view; Fig. 2, summit view, the sutures between the plates being too obscure to illustrate; Fig. 3, azygous side of the same specimen.

Species large. Calyx subhemispheroidal, broadly truncated, at the base, and constricted below the arm bases. Radial ridges mere rounded elevations across the plates which are interrupted by central nodes. Surface ornamented with numerous radiating ridges that do not coalesce in the centers of the plates. Column large, round and having a remarkably large, cinque-foil canal.

Basal plates hidden by the column and a rounded rim that surrounds it, on the basals and at the commencement of the first primary radials. First primary radials wider than long and of unequal size, two of them, on the azygous side, being larger than the others, as shown in the upper part of figure 1. Second primary radials large, about one-half wider than long, quadrangular, sides nearly parallel. Third primary radials rather longer and wider than the second, pentagonal, axillary and bear upon each superior sloping side a single secondary radial. The secondary radials are of unequal size, part heptagonal and part hexagonal, and bear upon each superior sloping side four tertiary radials. The first tertiary radials are moderately large, the others are quite short. There are, therefore, twenty arms and twenty ambulacral openings to the vault in this species. There are no intersecondary or intertertiary plates.

The first interradials are very large plates and have nine sides. They are followed in the second range, by a single plate, which is about half or less than half the size of the first. In some of the areas, there are two plates and in others three plates, in the third range, that connect with the plates of the vault. The azygous area is wider than either of the regular areas and the first plate is the largest in the calyx and has eleven sides. The additional sides are produced by abutting against the first tertiary radials, which the first plate in the regular areas does not reach. It is followed in the second range by a single plate larger than the second plate in the regular areas. There are three plates in the third range that unite with the plates of the vault.

The vault is moderately convex over the ambulacral areas and depressed in the interradial areas, most depressed in the azygous area. Most of the sutures between the plates of the vault are destroyed, in our specimen, but where the plates can be distinguished, they are large. The proboscis seems to be complete, in our specimen, and, as may be seen in the illustrations, the plates are merely elevated around a subcentral azygous opening. There is a minute orifice on each side of each arm base, which we suppose represent the ovarian apertures, but they are so small for so large a specimen that we suppose the silicification has partly closed them. They are not down in the interradial areas, as in other species, but are differently located.

The general form, surface ornamentation, interradial and azygous areas and twenty arms will readily distinguish this species from all others that have been described. It is a marked and beautiful species.

Found in the Hamilton Group, at Charlestown, Indiana, and now in the collection of Wm. F. E. Gurley.

DOLATOCRINUS HAMMELLI, n. sp.

Plate V, Fig. 4, basal view, the rim around the cavity is a little out of shape in the specimen, and is subpentagonal instead of hexagonal; Fig. 5, side view; Fig. 6, summit view of the same specimen.

Species medium size. The specimen illustrated is the smallest of six before us, but the largest is not more than one-fourth more in diameter. Calyx low, basin-shaped, specially expanded at the arms, from three and a half to four and a half times as wide as high, deeply and broadly concave below, the depression extending to the third radials. Columnar pit funnel-shaped, and bounded externally by a pentagonal, raised ridge running from a tubercle in the middle of the superior part of each first radial plate to the next adjoining. Radial ridges merely sharp elevations crossing the plates and interrupted by sharp nodes at the center of each plate. Surface radiately sculptured. Column round, inserted into the cup formed by the basal plates, and having a cinque. Foil columnar canal.

Basal plates form a round cup so deeply inserted in the calyx that it rises, in some specimens, higher than the calyx, and ends in the cavity of the vault. The mouth of the cup is one-third wider than the diameter of the column. First primary radials as wide as high, smooth below the pentagonal rim and tubercles from which the radial ridges arise, slightly sculptured above. Second primary redials twice as wide as high, slightly expanding above and quadrangular. Third primary radials expanding upward to the lateral angles, longer than the second, pentagonal, and supporting, in one ray upon each upper sloping side, a single secondary radial, which is axillary, and supports upon each upper sloping side two tertiary radials, which gives to this ray four arms. In each of the other four rays the third primary radial bears upon one upper sloping side three secondary radials, and upon the other a single secondary radial, which is axillary and bears upon each upper sloping side two tertiary radials, which gives to each of these rays three arms. There are, therefore, sixteen arms and sixteen ambulacral openings to the vault in this species.

The first regular interradials are elongated, nine-sided plates, peculiarly sculptured, by having one deep longitudinal furrow in the upper part. They are followed in the second range by a single plate, and above this there are two small plates that unite with the plates of the vault. The azygous area is a little larger than a regular interradial area and the plates are larger, otherwise it appears to be the same.

The vault is convex, most tumid on the azygous side, and bears a subcentral proboscis. The plates are large and most elongated in the interradial areas. The proboscis is evidently nearly complete in the specimen illustrated. It may have had another small row of plates at the top surrounding the azygous orifice. There are two elongated "ovarian apertures" with furrows prolonged across the top of the calyx in each interradial area, and two separating the arms in each of the five rays, which gives to this species twenty of these apertures. They are large and in striking contrast with the small ones in *Dolatocrinus corporosus*, shown in figure 2.

This species is distinguished by its general form, surface ornamentation and sixteen arms.

Found in the Hamilton Group at Charlestown, Indiana, and now in the collection of J. F. Hammell at Madison, Indiana, in whose honor we have proposed the specific name, and it is also in the collection of Wm. F. E. Gurley.

DOLATOCRINUS VASCULUM, n. sp.

Plate V, Fig. 7, basal view; Fig. 8, summit view, part of the vault broken away and showing the columuar canal at the end of the basal plates; Fig. 9, azygous side view.

Species large. Calyx broadly truncated and concave below, the concavity embracing the first primary radials, and subcylindrical above. All the plates are ventricose or subspinous and finely furrowed, radiately toward the margins. The surface ornamentation resembles that on *Dolatocrinus amplus*, but is more delicate, and the nodes more pointed.

Basals deeply sunken in the concavity and forming a pentagonal rim nearly twice as wide as the diameter of the column. First primary radials wider than long and each having a transverse obtuse node on the superior third. The two on the azygous side are the larger. Second primary radials quadrangular, about twice as wide as high and each bearing a transverse central node.

Each plate bears a long central node or spine, from the base of which, small lines radiate to the adjacent plates. Column small, round, and inserted in the cup formed by the basal plates.

Basal plates form the lower part of the funnel-shaped basal concavity, and at the top have a diameter one-half greater than the diameter of the column. First primary radials wider than long, and bear a ridge extending from the superior middle part of one to the superior middle part of the adjacent ones so as to form a pentagonal rim to the funnel-shaped basal concavity and on which the calyx will rest. The radial ridges arise from the angles of this pentagon. Second primary radials a little wider than high, quadrangular, sides parallel. Third primary radials about the same size as the second, pentagonal, axillary and support on each upper sloping side two tertiary radials. This gives to the species ten arms, which are composed of a single series of plates.

The first interradials are the largest plates in the body. They are followed by a single plate in each area; about one-third as large as the first, which unites with two plates belonging to the vault. In the azygous interradius the second plate unites with three plates belonging to the vault, which is the only difference between the interradial areas.

The vault is convex over the ambulacral furrows and abruptly depressed in the interradial areas, and bears a short central probosis. The vault is covered by two circles of large plates, the inner circle has seven plates, and within it there is an extra plate and then four plates stand upright and form the probosis which bears the azygous opening. There is an "ovarian aperture" on each side of the base of each arm, or twenty of these orifices in this species. It will be noticed that, in some species, these apertures are in the interradial areas, at some distance from the arms, while in this and some other species, they are not in the interradial depressions, but elevated and close to the ambulacral openings.

This species is most nearly related to *Dolatocrinus bulbaceus*, but differs in the general form and surface ornamentation. This species has an azygous side and "ovarian apertures," while that species has neither. Four specimens belonging to this species possess the same characters, and differ only, in the fact, that the nodes or spines on some specimens are longer than on others.

tured in fascicles of fine lines from the central nodes, which makes the ornamentation complicated and beautiful. Column large, round, and has a large cinque-foil canal.

Basals form a flat, pentagonal disc only a little larger than the diameter of the column. First primary radials wider than long, and the calyx will rest upon the central nodes. Second primary radials about one-half wider than long, quadrangular. Third primary radials, expand to the superior lateral angles, a little wider than long, pentagonal, axillary, and bear upon each superior sloping side, in four of the rays a single secondary radial, which is axillary and bears upon each upper sloping side two tertiary radials, which gives to each of these rays four arms. In one of the lateral rays, one of the superior sides of the third primary radial bears three secondary radials, and the other a single secondary radial, which is axillary and bears upon each upper sloping side two tertiary radials which gives to this ray three arms. There are, therefore, nineteen arms in this species and nineteen ambulacral openings to the vault.

The first interradials are the largest plates in the calyx and are followed by a single plate except in the azygous area where there are two.

The vault is convex over the ambulacral areas and sharply depressed in the interradial areas, and bears a subcentral azygous opening but slightly elevated above the central part of the vault. Only a few of the sutures could be distinguished, and they are shown, in the illustration in the azygous interradial depression.

This is a very beautiful species and will be readily recognized by its general form, surface ornamentation and nineteen arms.

Found in the Hamilton Group, in Charlestown, Indiana, and from the collection of Wm. F. E. Gurley.

DOLATOCRINUS PULCHELLUS, n. sp.

Plate 5, Fig. 13, basal view; Fig. 14, side view; Fig. 15, summit view.

Species below medium size. Calyx bowl-shaped, slightly contracted below the arms, truncated below and having a funnel-shaped basal concavity. Radial ridges small, sharply angular.

Each plate bears a long central node or spine, from the base of which, small lines radiate to the adjacent plates. Column small, round, and inserted in the cup formed by the basal plates.

Basal plates form the lower part of the funnel-shaped basal concavity, and at the top have a diameter one-half greater than the diameter of the column. First primary radials wider than long, and bear a ridge extending from the superior middle part of one to the superior middle part of the adjacent ones so as to form a pentagonal rim to the funnel-shaped basal concavity and on which the calyx will rest. The radial ridges arise from the angles of this pentagon. Second primary radials a little wider than high, quadrangular, sides parallel. Third primary radials about the same size as the second, pentagonal, axillary and support on each upper sloping side two tertiary radials. This gives to the species ten arms, which are composed of a single series of plates.

The first interradials are the largest plates in the body. They are followed by a single plate in each area; about one-third as large as the first, which unites with two plates belonging to the vault. In the azygous interradius the second plate unites with three plates belonging to the vault, which is the only difference between the interradial areas.

The vault is convex over the ambulacral furrows and abruptly depressed in the interradial areas, and bears a short central probosis. The vault is covered by two circles of large plates, the inner circle has seven plates, and within it there is an extra plate and then four plates stand upright and form the probosis which bears the azygous opening. There is an "ovarian aperture" on each side of the base of each arm, or twenty of these orifices in this species. It will be noticed that, in some species, these apertures are in the interradial areas, at some distance from the arms, while in this and some other species, they are not in the interradial depressions, but elevated and close to the ambulacral openings.

This species is most nearly related to *Dolatocrinus bulbaceus*, but differs in the general form and surface ornamentation. This species has an azygous side and "ovarian apertures," while that species has neither. Four specimens belonging to this species possess the same characters, and differ only, in the fact, that the nodes or spines on some specimens are longer than on others.

The smallest specimen has only two-thirds the diameter of the one illustrated, and the largest specimen has a diameter one-fifth greater than the one illustrated.

Found in the Hamilton Group, at Charlestown, Indiana, and from the collection of Wm. F. E. Gurley.

DOLATOCRINUS BELLULUS, n. sp.

Plate V, Fig. 16, basal view; Fig. 17, azygous, side view; Fig. 18, summit view.

Species above medium size. Calyx hemisperical, broadly truncated below. Radial ridges consist of small round ridges crossing the central part of the plates, and interrupted by prominent nodes in the center of each plate. Nodes larger and more or less transverse on the interradials. Surface ornamented by fascicles of lines radiating from the central nodes. Column large, round, and bearing a large cinque-foil columnar canal.

Basal plates almost covered by the column, and bearing a small circular ridge around the facet for the attachment of the column. First primary radials wider than long, the two on the azygous side being larger than the others. Second primary radials about one-half wider than long, quadrangular. Third primary radials expand to the superior lateral angles, longer than the second, pentagonal, axillary, and in two of the rays each bears upon each superior sloping side a single secondary radial, which is axillary, and bears upon each superior sloping side two tertiary radials, which gives to each of these rays four arms. These two rays adjoin the azygous area. In each of the other three rays the third primary radial bears upon one sloping side three secondary radials, and upon the other one secondary radial, which is axillary and supports upon each upper sloping side two tertiary radials. This arrangement gives to each of these rays three arms. There are, therefore, seventeen arms and seventeen ambulacral openings to the vault in this species.

The azygous area is like the others except a little larger. The first interradials are the largest plates in the calyx, have nine sides and are broadly truncated above for the second interradials. The second interradials are about half as large as the first, and are followed by a single plate in the third range, which unites with plates belonging to the vault.

The vault is convex, bears a small central proboscis, and is substantially covered by three circles of large plates. Some of the sutures are anchylosed in the larger circle of plates, and hence they are not shown in the illustration. There are seven plates in the middle circle, and five at the base of the short central proboscis that contains the azygous opening. The surface of the plates is destroyed, but a node may be seen on each plate over the junction of the ambulacral canals. There is a small "ovarian aperture" close to each side of each ambulacral opening, which gives to this species thirty-four of these openings.

This species is readily distinguished from all others by its general form, surface ornamentation, and seventeen arms.

Found in the Hamilton Group, at Charlestown, Indiana, and from the collection of Wm. F. E. Gurley.

FAMILY CARYOCRINIDÆ.

FAMILY STRIBALOCYSTIDÆ. (?)

STRIBALOCYSTITES SPHÆROIDALIS, n. sp.

Plate V, Fig. 19, anterior side; Fig. 20, basal view, plates injured a little where the column attached; Fig. 21, summit view.

Body broadly obovate and expanded into an obtuse rim below the summit. Surface of the plates granular, those on the vault convex. Sutures beveled.

Basals four, of unequal size, and forming an irregularly expanded cup with an hexagonal summit, and slightly re-entering angles at the sutures. Second series of plates expand to the upper third, where they are tumid and abruptly bent over toward the summit, two pentagonal, two hexagonal and two heptagonal. The heptagonal plates are the larger plates in this series. There are eight plates in the third series, of unequal size, and not in line by reason of curving over the large heptagonal plates in the second series. They are slightly convex and directed toward the summit of the body. Two of them adjoin the mouth which is surrounded by four plates.

The entire summit is covered by seven plats, four of the larger of which occupy the central part of the summit, and there is one minute plate on one side of these and two small plates on the other side. There are four orifices on the summit, one of which is as large as the mouth, and directly back of it, and surrounded by four plates, two of which belong to the third series of plates. The other two are smaller and each surrounded by three plates, the smallest passes between plates belonging to the summit, and the other is at an angle of two plates in the third range. One of the summit plates adjoining the mouth bears a prominent node.

This species is so distinct from either of the others in form and surface ornamentation and in the summit plates that no comparison with either is necessary to distinguish it. It will be observed, that the summit plates and orifices differ greatly in this genus, which reduces them to matters of specific importance only, The number of plates in each range below the summit agree with those in *Caryocrinus.* The pores in *Caryocrinus* may be of generic importance, but it is not likely that they are of family importance. Considering the fact that within the range of a genus the species vary among Cystideans more than elsewhere, and allowing like latitude, in the classification of the genera into families, we may place the genus *Stribalocystites* in the family *Caryocrinidæ.* This view is strengthened by the fact that all the forms are from the same group of rocks.

Found in the Niagara Group, at St. Paul, Indiana, and now in the collection of Wm. F. E. Gurley.

CARYOCRINUS KENTUCKIENSIS, n. sp.

Plate V, Fig. 22, anterior side; Fig. 23, posterio-lateral side; Fig. 24, summit view.

Species small, subelliptical longitudinally. Plates more or less convex, and bearing a few very small pores. The pores are so small that they can only be seen by the aid of a magnifier, and hence are not shown in the illustrations. The surface of the plates is sculptured, but our specimen does not preserve these markings, so as to describe them. The sutures are beveled. The body is not constricted below the arms, and is only truncated below to the extent of the diameter of the column.

Basals form a low subhexagonal cup with a hexagonal summit, and slightly re-entering angles at the sutures. The base is concave for the attachment of the column, and bears a round orifice for the columnar canal. The plates in the second range are longer than wide, and stand nearly upright, two pentagonal, two hexagonal and two heptagonal. The plates in the third range are about half the size of those in the second, and form an irregular range. They are of unequal size and shape, and surround an elongated, irregular, convex summit.

The summit is covered by eighteen plates, fifteen of which are quite small and some of them minute. There are six small openings surrounding the summit beside the mouth. They are supposed to represent the places for the attachment of the arms, and adjoin the plates in the third range except one which seems to be separated by a minute plate. The arm openings are in three pairs. The mouth is surrounded by four plates, one of which belongs to the third range. It will, therefore, be observed that the summit is covered with a number of small plates which are in no manner connected with the orifices, and which preserve no definite order of arrangement. The central one is surrounded with seven plates, and the other ten plates have no order of arrangement, as may be seen on figure 24.

This species is so different from all others heretofore described that no comparison is necessary with any of them. It furnishes another illustration of the great diversity of forms belonging to a single genus among the Cystideans.

Found in the Niagara Group, at Louisville, Kentucky, and now in the collection of Wm. F. E. Gurley.

FAMILY PLEUROCYSTIDÆ.

PLEUROCYSTITES MERCERENSIS, n. sp.

Plate V, Fig. 25, dorsal view slightly broken at the anterior end; Fig. 26, basal view of same.

Body irregularly subovate, and irregularly concavo-convex. There are three plates on the dorsal side that do not extend to the margin; each of these at the distal sides bears a pectinated rhomb. The two anterior ones have the rhombs located near the superior lateral margins, and the posterior one has the rhomb near the column. The left anterior rhomb is the largest. They are all somewhat elongate ovate, and have their longer diameters directed toward a central point between them, and they are striated longitudinally so that the striæ are also directed in the same way. The plates are radiately sculptured from the rhombs, but most of the striæ are destroyed on our specimen. All other plates on the dorsal side curve over and cover part of the ventral side. The ventral side is concave, and possesses a large oval space covered with very numerous minute plates. The column is elliptical, and has its shorter diameter equal to the greatest thickness of the body.

This species has one plate less in the first range than there is in *P. squamosus*, the species to which it would seem to be the nearest. The rhombs are different in form from those belonging to other species, and have their longer axes directed differently. There are minor differences that will distinguish it from other species also, and the general form will probably be sufficient in all cases. We have used the family name *Pleurocystidæ* provisionally, without defining it, because this genus cannot belong to the *Lepadocrinidæ*, where it has been placed heretofore. The family relations among Cystideans are not well understood.

Found by Prof. A. G. Wetherby, in the Trenton Group, in Mercer County, Kentucky, and now in the collection of Wm. F. E. Gurley.

ORDER CYCLOCYSTOIDEA.

FAMILY CYCLOCYSTOIDIDÆ.

CYCLOCYSTOIDES ILLINOISENSIS, n. sp.

Plate V, Fig. 27, outer rim of a part of a specimen; Fig. 28, outer rim of part of another specimen.

This species is large and the outer rim is composed of a great many plates. One of our specimens which does not appear to be more than one-third of a circle, has nine plates. The other specimen, which does not appear to be much, if any, more than one-half of the circle, has thirteen plates. The inference is that a complete specimen will have from twenty-four to thirty plates. The outer part or margin of the rim bears four or five rows of elongated nodes, such as have not, we believe, been heretofore found on any specimen.

The great number of plates, in the rim, and the elongated nodes on the margin will distinguish this species from all that have been heretofore described.

Found in the Hudson River Group on Orchard Creek, Alexander county, Illinois, and now in the collection of Wm. F. E. Gurley.

Through an oversight, proper credit was not given in Bulletin No. 5 to Prof. A. G. Wetherby, who discovered all the forms therein described from the Trenton Group of Mercer county, Ky., and Knox county, Tenn.; also, those from the Kaskaskia Group, of Pulaski county, Ky., as well as those from the Keokuk Group of Tennessee, in all some fifteen species, including one new family and three new genera. And the opportunity is here taken not only to make this correction, but to express to Prof. Wetherby our sincere thanks for the valuable assistance he has rendered in securing interesting specimens, as well as valuable information.

PLATE I.

Page.

BATOCRINUS SPINOSUS, n. sp. 5
Fig. 1. Azygous side.
Fig. 2. View opposite azygous side.
Fig. 3. Basal view.

BATOCRINUS CURIOSUS, n. sp. 6
Fig. 4. Azygous side.
Fig. 5. View opposite azygous side.
Fig. 6. Basal view.

BATOCRINUS CASULA, n. sp. 8
Fig. 7. Azygous side.
Fig. 8. Lateral view.

BATOCRINUS HONORABILIS, n. sp. 10
Fig. 9. Azygous side.
Fig. 10. View opposite azygous side.

BATOCRINUS WETHERBYI, n. sp. 11
Fig. 11. Azygous side.
Fig. 12. View opposite azygous side.

BATOCRINUS LATERNA, n. sp. 12
Fig. 13. Lateral view, azygous area to the right.
Fig. 14. Basal view, showing large diameter of the basal plates.

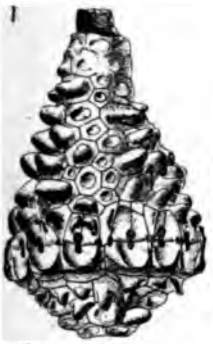
BATOCRINUS LACINIOSUS, n. sp. 14
Fig. 15. Lateral view.
Fig. 16. Azygous view.

BATOCRINUS CASUALIS, n. sp. 15
Fig. 17. Lateral view.
Fig. 18. Azygous view.

ILL. STATE MUS. OF NAT. HIST.

Bulletin No. 6. **Plate I.**

1



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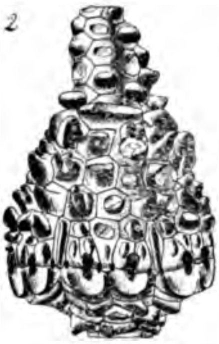

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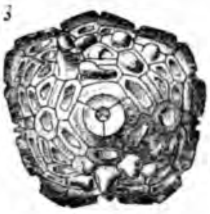

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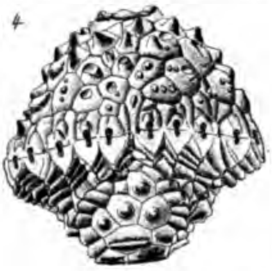

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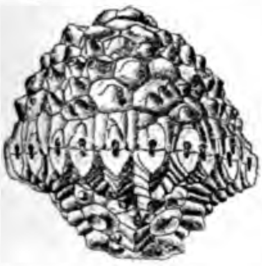

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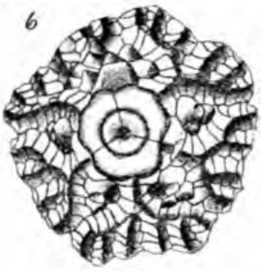

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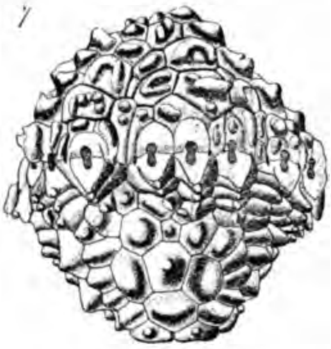

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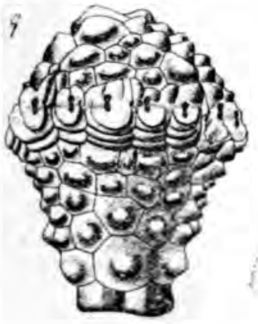

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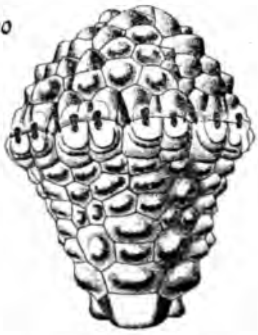

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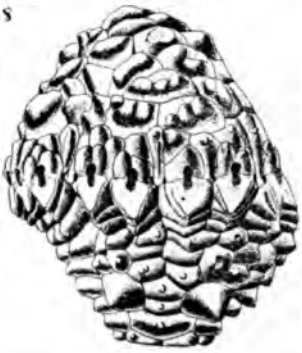

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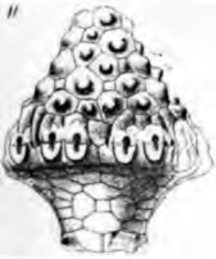

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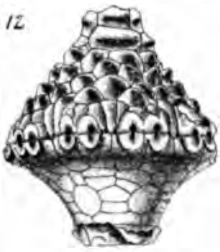

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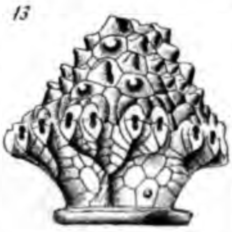

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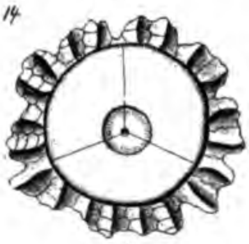

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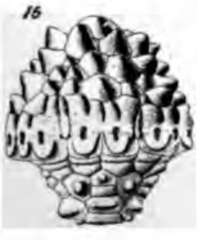

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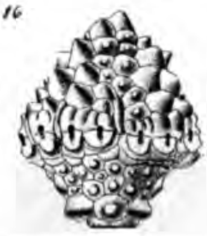

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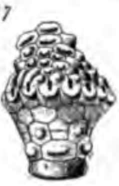

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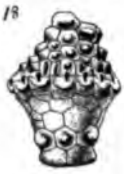

A. ALBERS. DEL.

PLATE II.

	Page.
ACTINOCRINUS BOTRUOSUS, n. sp.	23
Fig. 1. Azygous side.	
Fig. 2. View opposite azygous side.	
BATOCRINUS ARCULA, n. sp.	16
Fig. 3. Azgous side.	
Fig. 4. Summit view.	
Fig. 5. Basal view.	
BATOCRINUS PILEUS, n. sp.	18
Fig. 6. Basal view.	
Fig. 7. Summit view.	
Fig. 8. Lateral view.	
BATOCRINUS BURKETI, n. sp.	19
Fig. 9. View of a specimen showing column, arms and azygous side of calyx.	
BATOCRINUS LABELLUM, n. sp.	21
Fig. 10. Azygous side.	
Fig. 11. Basal view.	
Fig. 12. Summit view.	
SACCOCRINUS UMBROSUS, n. sp.	24
Fig. 13. Lateral view, azygous area to the right.	
Fig. 14. Lateral view, azygous area to the left.	
ERETMOCRINUS COMMENDABILIS, n. sp.	25
Fig. 15. View of a specimen showing column, arms and calyx.	
PLATYCRINUS VASCELLUM, n. sp.	32
Fig. 16. Basal view.	
Fig. 17. Lateral view.	
Fig. 18. Summit view.	

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Bulletin No. 6. **Plate II.**

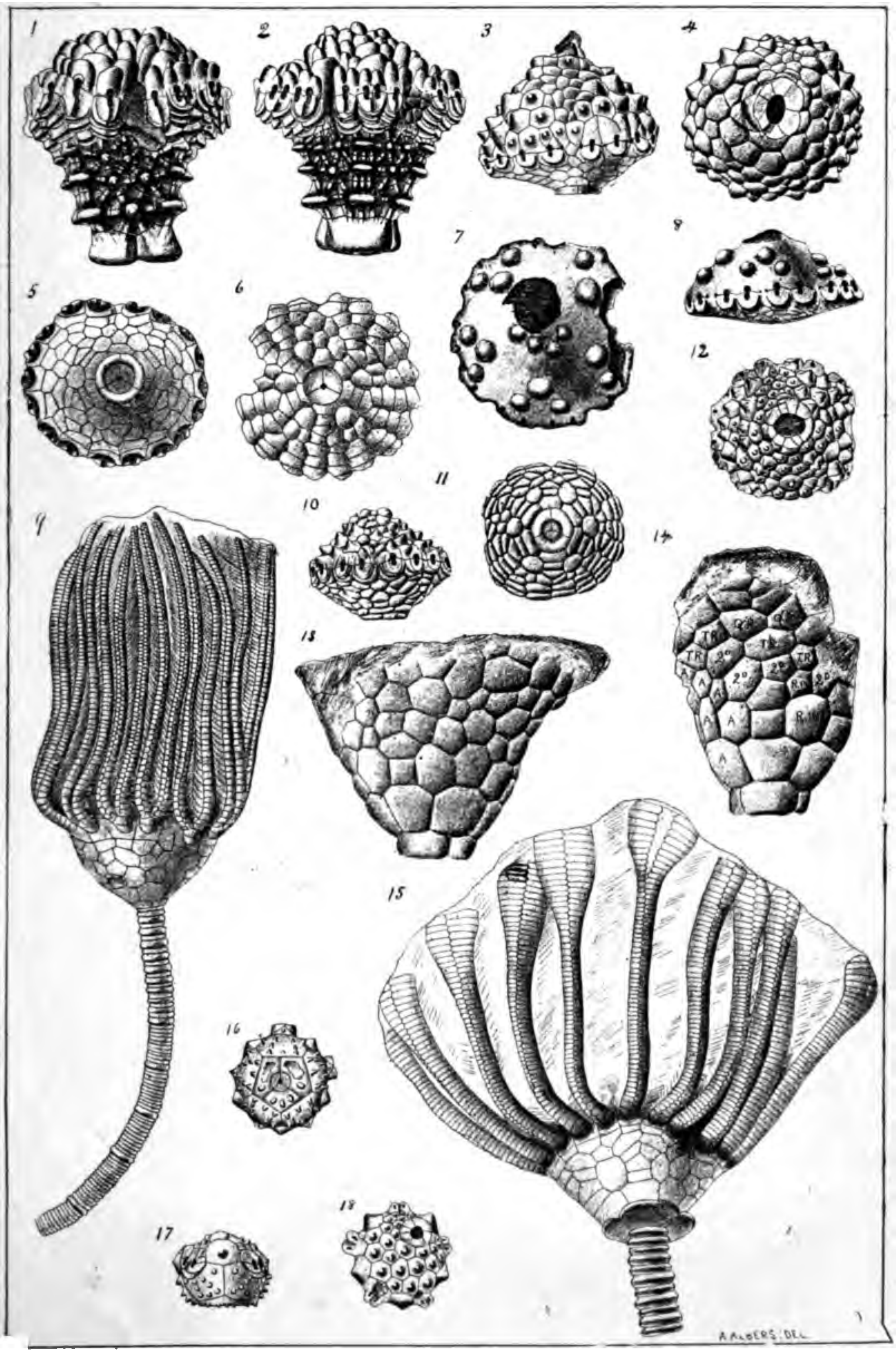

PLATE III.

Page.

Agaricocrinus profundus, n. sp. 26
Fig. 1. Basal view.
Fig. 2. Summit view.
Fig. 3. Azygous side view of a smaller specimen.

Agaricocrinus turguium, n. sp. 28
Fig. 4. Basal view.
Fig. 5. Summit view.
Fig. 6. Azygous side view.

Agaricocrinus arcula, n sp. 30
Fig. 7. Basal view.
Fig. 8. Summit view of a smaller specimen.
Fig. 9. Azygous side view of same.

Archæocrinus knoxensis, n. sp. 34
Fig. 10. Basal view.
Fig. 11. Azygous side view.
Fig. 12. Summit view.

Gilbertsocrinus greenei, n sp. 35
Fig. 13. Basal view.
Fig. 14. Lateral view.
Fig. 15. Summit view.

Gilbertsocrinus indianensis, n. sp 32
Fig. 16. Basal view of a specimen showing some complete spines.
Fig. 17. Basal view of another specimen.
Figs. 18 and 19. Lateral views of the same.
Fig. 20. Basal view of a smaller specimen, probably of the same species.
Fig. 21. Summit view of the same.
Fig. 22. Lateral view of the same.

Macrostylocrinus indianensis, n. sp. 33
Fig. 23. Side view of calyx.

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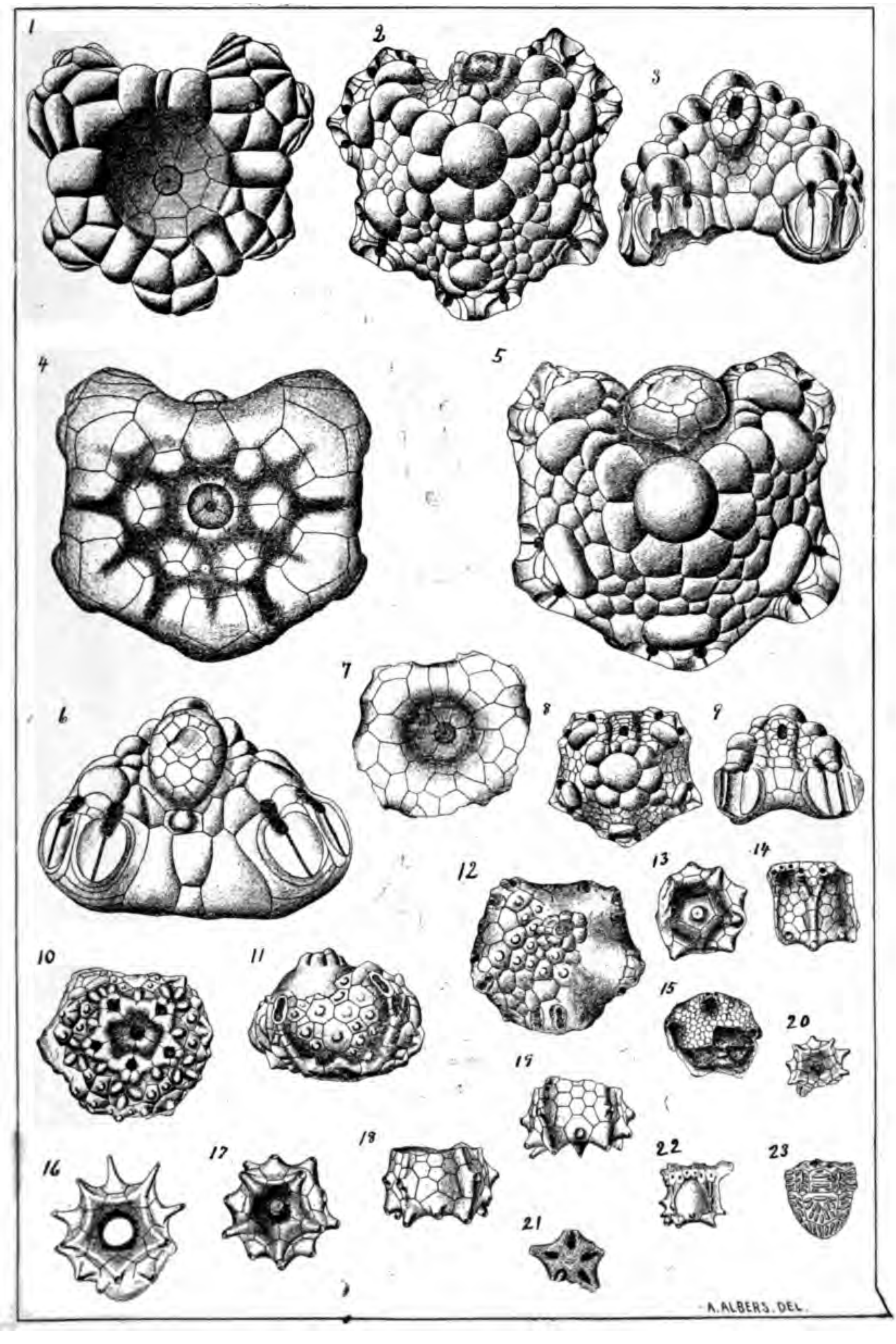
Bulletin No. 6. **Plate III.**



A. ALBERS, DEL.

PLATE IV.

Page.

ONYCHOCRINUS PULASKIENSIS, n. sp. 40
Fig. 1. View showing column and part of arms.
Fig. 2. Azygous side of the same.

TAXOCRINUS WETHERBYI, n. sp. 41
Fig. 3. Basal view, azygous side down.
Fig. 4. Lateral view.
Fig. 5. Summit view.

PTEROTOCRINUS WETHERBYI, n. sp. 44
Fig. 6. Azygous side view.
Fig. 7. Basal view, azygous side down.
Fig. 8. Summit view.
Fig. 9. View of another specimen, showing furrowed vault.

POTERIOCRINUS VAGULUS, n. sp. 45
Fig. 10. Lateral view, azygous area to the left.
Fig. 11. Opposite side of the same.

ZEACRINUS PULASKIENSIS, n. sp. 47
Fig. 12. Azygous side view.
Fig. 13. Opposite side of same.

ZEACRINUS DURABILIS, n. sp. 48
Fig. 14. Azygous side view.
Fig. 15. Opposite side of same.

EMPEROCRINUS INDIANENSIS, n. sp. 48
Fig. 16. Basal view.
Fig. 17. Azygous side view.

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Fig. 21. Azygous side view.
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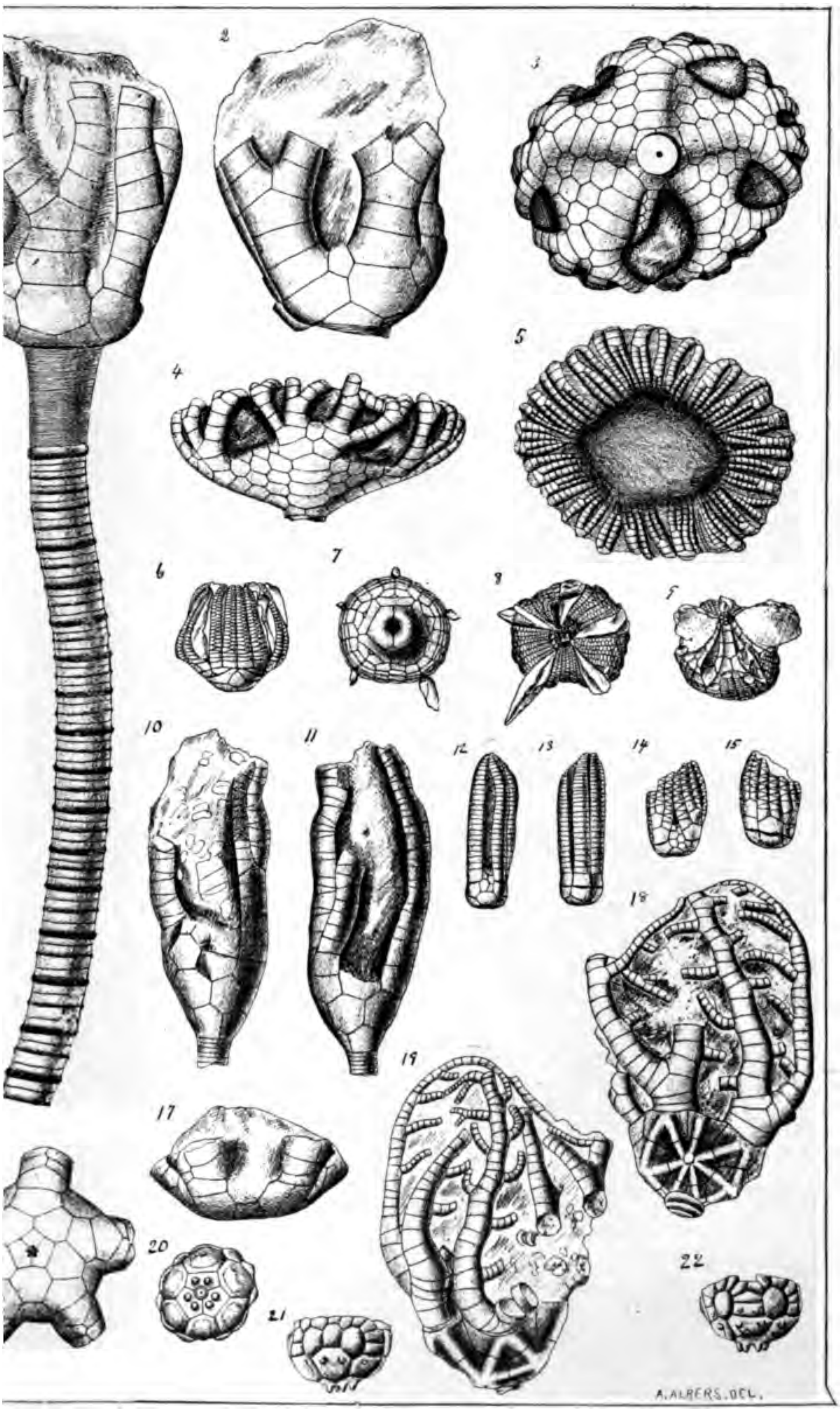
Plate IV.



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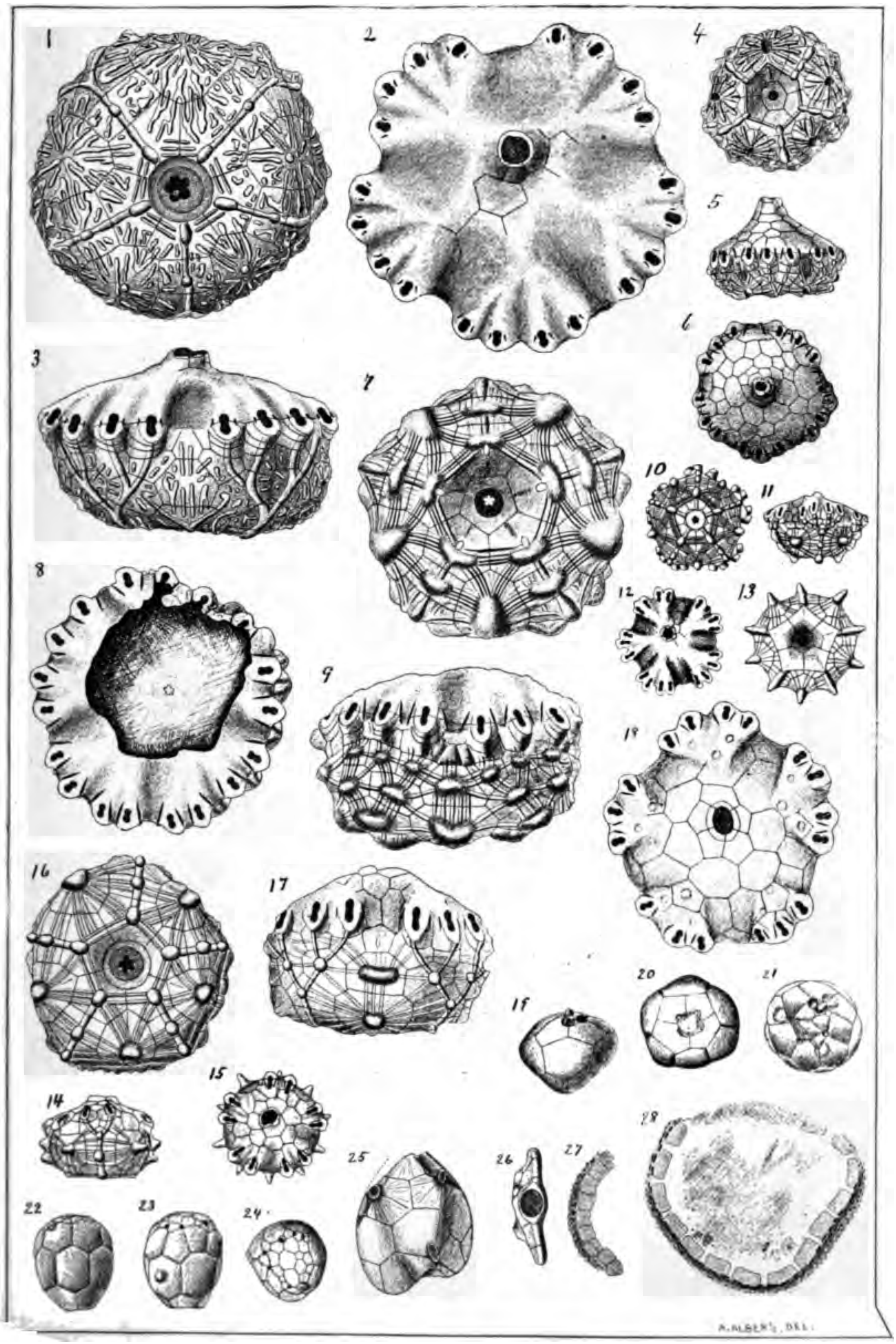

A. ALBERS, DEL.

J C Branner

BULLETIN NO. 7

OF THE

ILLINOIS STATE MUSEUM

OF

NATURAL HISTORY

NEW AND INTERESTING SPECIES OF PALÆOZOIC FOSSILS.

BY S. A. MILLER AND WM. F. E GURLEY.

SPRINGFIELD, ILLINOIS,
DECEMBER 5, 1895.

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NEW AND INTERESTING SPECIES OF PALÆOZOIC FOSSILS.

BY S. A. MILLER AND WM. F. E. GURLEY.

SUBKINGDOM ECHINODERMATA.

CLASS CRINOIDEA.

ORDER PALÆOCRINOIDEA.

FAMILY ACTINOCRINIDÆ.

BATOCRINUS POLYDACTYLUS, n. sp.

Plate I, Fig. 1, view of calyx, arms and part of the column, azygous area on the right.

Species above medium size. Clayx short, saucer-shaped, about four times as wide as high; interradial areas slightly flattened; surface granular. Column medium size and composed of alternately larger and smaller plates.

Basals form an hexagonal disc. less than twice the diameter of the column, bearing a low rim around the depression for the attachment of the column. First primary radials more than twice as wide as high. Second primary radials quadrangular, nearly three times as wide as high. Third primary radials not much larger than the second, twice as wide as high, pentagonal, axillary, and support upon the upper sloping sides the secondary radials. In each lateral ray and in the ray opposite the azygous area there are two secondary radials, the last of which are axillary and bear three tertiary radials, the last one being axillary and bearing two arms; which gives to each of these rays eight arms. The ray on the right of the azygous area bears three secondary radials, the last one being axillary and bearing two arms, which gives to this ray four arms. The ray on the left of the azygous area bears, on the distal side, three secondary radials. the last of which is axillary, and on the proximal side two secondary radials, the last of which is axillary, and bears on the distal side two tertiary radials, and on the proximal side three tertiary radials, the last one being axillary, giving to this ray five arms. There are, therefore, thirty-three arms in this species. The arms are composed of a double series of interlocking plates that are deeper than wide in the lower part, but commence to spread, at the upper third, and become perfectly flat, in the upper part, as they do in *Eretmocrinus*, but without the usual increase in width. The plates of the arms do not seem to lengthen, but instead of closing, so as to have an ambulacral furrow on the inner side, they become perfectly flat on both sides, or concave externally. Pinnules dense.

There are three regular interradials in each area, one large, the other two small, but of unequal length. There are seven azygous interradials, the first one heptagonal, in line with the first primary radials, and of about the same size. It is followed by three plates, in the second range, the middle one being the longer and larger one. On each side of the upper part of the middle plate there is a small plate that separates it from the radial series. Above the middle plate of the second range, there is an elongated plate that extends an angle to the top of the calyx. The vault is not exposed, but it bears a long slender proboscis, the end of which is broken off at the top of the specimen illustrated.

This specie will be distinguished by its depressed calyx, and thirty-three arms or seventeen ambulacral orifices, in the vault, and by the flattening of the arms in the superior part. This latter character, in a greater degree, possibly, has been regarded as a generic character in *Eretmocrinus.* This species and others hereinafter described show that the flattening of the arms is not of generic importance. Many species of *Batocrinus* show the tendency of the arms to expand or flatten toward the superior ends.

Found in the Keokuk Group, at Boonville, Missouri, and now in the collection of S. A Miller.

BATOCRINUS SAMPSONI, n. sp.

Plate I, Fig. 2, azygous view of a specimen compressed so as to show calyx and arms; Fig. 3, lateral view of another specimen having part of the arms removed, showing vault, proboscis and the incurving part of the arms, some of which are broken off.

Species medium size. Calyx obconoidal, twice as wide as high; each radial series where unworn bears a slight angular ridge from the basal plates to the free arms; interradial areas flattened but very little; surface granular; truncated for a small column.

Basals form an hexagonal disc, one-half wider than the diameter of the column, and having a height less than the distance from the column to the margin. First primary radials wider than high, upper face slightly arcuate for the reception of the second radials. Second primary radials quadrangular, about twice as wide as high. Third primary radials pentagonal, a little larger than the second, not quite twice as wide as high, axillary, and support upon the upper sloping sides the secondary radials The distal side of each third primary radial, adjoining the azygous area, bears four secondary radials, the last of which is axillary, and supports upon each upper sloping side a free arm; the proximal side of each bears two secondary radials, the last of which is axillary and supports upon the distal side two tertiary radials, the last one being axillary and supporting upon each upper sloping side a free arm; the proximal side of each secondary radial bears three tertiary radials that support a single arm. This arrrngement gives to each of these rays five arms. In each lateral ray there are two secondary radials, the last one being axillary and supporting the tertiary radials. In one of these each distal series supports four tertiary radials, the last one being axillary and supporting upon each upper sloping side a free arm, and each proximal series supports three tertiary radials, the last of which supports a free arm which gives to this lateral ray six arms. In the other lateral ray, one of the distal series supports three tertiary radials, the last one being axillary and supporting upon each upper sloping side a free arm; the other distal series and each proximal series, support three tertiary radials each of which supports a free arm, which gives to this lateral ray five arms. In the ray opposite the azygous area there are four secondary radials, the last of which is axillary and supports upon each upper sloping side a free arm, which gives to this ray four arms. There are, therefore, twenty-five arms, in this species. The arms are composed of a double series of interlocking plates that are deeper than wide, in the lower part, but flatten out above as they do in *Eretmocrinus*, but without the usual increase in width. Pinnules long and dense.

There are three regular interradials in each area, one large, the other two smaller and somewhat elongated. There are six azygous interradials, the first one heptagonal, in line with the first primary radials, and the largest plate in the calyx. It is followed by three plates, the central one being smaller than the lateral ones; and these by two elongated plates that connect with the plates of the vault. The vault is conoidal and larger than the calyx, and bears a long subcentral proboscis. The plates of the vault and proboscis are large and smooth.

This species will be distinguished by its general form, and twenty-five arms that are flattened toward their terminal ends. This latter character belongs to all species that have been referred to *Eretmocrinus*. This species and others herein described show that the flattening of the arms is not of generic importance, though, in a marked degree, it is no doubt of specific value. We have, heretofore, shown that the other characters ascribed to *Eretmocrinus* are possessed by different species of *Batocrinus* and that one and all are not of generic value.

Found in the Keokuk Group, at Boonville, Missouri, and now in the collection of S. A. Miller. The specific name is in honor of F. A. Sampson, the well known naturalist of Sedalia, Missouri.

BATOCRINUS VETERATOR n. sp.

Plate I, Fig. 4, view of calyx and arms opposite the azygous side, a little depressed, and arms broken off at the upper end.

Species medium size. Calyx obconoidal, two and a half times as wide as high; no radial ridges; plates slightly convex; sutures distinct, somewhat beveled; surface granular; column small.

Basals form an hexagonal disc twice as wide as the diameter of the column and having a height less than half the distance from the column to the margin. First primary radials one-half wider than high, and superior face nearly straight. Second primary radials quadrangular, about three times as wide as long. Third primary radials pentagonal, a little larger than the second, about three times as wide as long, axillary, and support on the upper sloping sides the secondary radials. In the ray opposite the azygous area there are three secondary radials on one side and an axillary plate that bears two arms; on the other, there are two secondary radials, the last of which is axillary and bears, upon one side, a tertiary plate, which supports a single arm, and upon the other a tertiary plate, which is followed by an axillary plate that bears two arms. There are, therefore, five arms in this ray. One of the lateral rays is constructed in the same manner and bears five arms. In the other lateral ray there are two secondary radials in each series, the last of which are axillary and bear, upon one side, two tertiary radials that support a single arm on each, and upon the other side two tertiary raidials, the last being axillary and supporting two arms. There are, therefore, six arms in this ray. The ray on the right of the azygous area also supports six arms, while the ray on the left of the azygous area supports seven arms, the proximal one being a single arm and the other three double arms. By this arrangement there are twenty-nine arms in this species. The arms are long and very slightly flattened toward the superior ends. Pinnules very dense.

In the regular interradial areas there are only two plates, one following the other. In the azygous interradial area the first plate is heptagonal, in line with the first primary radials and of about the same size. It is followed by three plates in the second range, which nearly fill the area, above these the sutures are indistinct in each of our specimens, but, apparently, there is only one plate. making five plates in this area. The vault is not disclosed in our specimens, but two of them show the broken ends of the proboscis, which is quite small.

The arms, in the specimen illustrated, are broken off and eroded toward the top, which causes the arms to appear to flatten more than they really do. Another specimen showing nearly the entire length of the arms, shows only a little flattening at the tips—about the same shown in *B. venustulus*.

This species is distinguished by its general form, number of interradials, and the peculiarity in the arrangement of its twenty-nine arms.

Found in the Keokuk Group, at Boonville, Missouri, and now in the collection of S. A. Miller.

BATOCRINUS VETUSTUS, n. sp.

Plate I, Fig. 5, azygous side view of the calyx and part of the arms; Fig. 6, opposite view of the same specimen.

Species medium size. Calyx obpyramidal, twice as wide as high; each radial series bears an angular ridge from the basal plates to the free arms; interradial areas flattened; sutures slightly beveled; surface granular; truncated for a small column.

Basals form an hexagonal disc one-half wider than the diameter of the column and having a height less than half the diameter of the column. First primary radials wider than high, upper face slightly arcuate for the reception of the second radials. Second primary radials quadrangular, about twice as wide as high. Third primary radials pentagonal, except in the typical specimen, the one on the right of the azygous area is hexagonal, and the one opposite the azygous area is heptagonal, as shown in figure 5. Moreover, in the typical example, there are four primary radials, in one of the lateral series, as shown on the left of figure 6. The extra plate is pentagonal and inserted between the second and third primary radials. The third primary radials are of unequal size, axillary, and bear upon each upper sloping side secondary radials. On the right side of the azygous area, on the distal side, there are three secondary radials and an axillary plate that bears two arms, and on the proximal side two secondary radials, the last being axillary and bearing upon each upper side two tertiary radials, each of which bears a single arm, which gives to this ray four arms. On the left side of the azygous area, on the distal side, there are four secondary radials that bear a single arm, and on the proximal side two secondary radials, the last of which is axillary, and bears upon the distal side two tertiary radials that bear a single arm, and on the proximal side three tertiary radials, the last being axillary and supporting two arms, which gives to this ray four arms. It will be noticed that the number of arms in each of these rays is the same, but the arrangement is reversed. In one lateral ray there are upon each side of the third primary radial four secondary radials, the last being axillary and supporting two arms, which gives to this ray four arms. In the other lateral ray there are upon each side of the third primary radial two secondary radials, the last being axillary and bearing upon each upper sloping side three tertiary radials, the last of which is axillary in three rays and supports two arms, and the other one supports a single arm, which gives to this ray seven arms. In the ray opposite the azygous area there are upon one side five secondary radials that bear a single arm, and upon the other side five secondary radials, the last being axillary and supporting two arms, which gives to this ray three arms. There are, therefore, twenty-two arms in this species. The arms are composed of a double series of interlocking plates that are deeper than wide, and, as far as preserved in the typical specimens, show no tendency to flatten toward the superior ends. Pinnules long and dense.

In part of the regular interradial areas there are five plates, one followed by two, and then one in the third, and one in the fourth range—in other areas there are six plates—two in both the second and third ranges. In the azygous area there are thirteen plates. The first one is heptagonal, in line with the first primary radials and fully as large as any of them. It is followed by three plates in the second range, five in the third range, three in the fourth range and one in the fifth range that unites with the plates of the vault. Our specimens do not disclose the vault and proboscis.

This species is distinguished by the numerous interradials and azygous plates, and by the order and arrangement of twenty-two arms. The fourth primary radial in one of the rays is abnormal, or the commencement of development toward some other form, that is unknown, provided other specimens, in this species, do not retain the same character, in which case, it might be a specific character. We have the character preserved, only in the specimen that is illustrated.

Found in the Keokuk Group, at Boonville, Missouri, and now in the collection of S. A. Miller.

BATOCRINUS VENUSTULUS, n. sp.

Plate I, Fig. 7, azygous side of calyx and arms, a little depressed.

Species medium size. Calyx obconoidal, twice as wide as high; each radial series bears a low angular ridge from the basal plates to the free arms; interradial areas slightly flattened; surface granular; truncated for a medium-sized column.

Basals form an hexagonal disc one-third wider than the diameter of the column and having a height less than the distance from the column to the margin. First primary radials very little wider than high, upper face slightly arcuate for the reception of the second radials. Second primary radials quadrangular, more than twice as wide as high. Third primary radials pentagonal, a little larger than the second, about twice as wide as high, axillary, and support upon the upper sloping sides the secondary radials. On the distal side of the third primary radial, on the right of the azygous area there are four secondary radials, the last of which is axillary and supports upon each upper sloping side a free arm; on the proximal side there are two secondary radials, the last being axillary and supporting upon the distal side two tertiary radials and upon the proximal side three, the last ones supporting free arms, which gives to this ray four arms. In the ray on the left of the azygous area, the third primary radial supports, upon each upper sloping side, two secondary radials, the last being axiliary and the proximal series bears on the proximal side two tertiary radials and on the distal side two tertiary radials and an axillary plate that supports two arms; the distal series bears upon each upper sloping side two tertiary radials one of which bears an axillary plate that supports two arms. This arrangement gives to this ray six arms.

In each lateral ray the third primary radial supports upon each upper sloping side two secondary radials the last being axillary and bearing upon each upper sloping side three tertiary radials and an axillary plate which supports two arms, which gives to each of these rays eight arms. In the ray opposite the azygous area, there are three secondary radials followed by an axillary plate that supports two arms, in one series, and, in the other, there are three arms, which gives to this ray five arms. There are, therefore, in this species, thirty-two arms. The arms are composed of a double series of interlocking plates that show a slight tendency to flatten at the incurving superior ends, but not to be compared in this respect with *Batocrinus Sampsoni*. Pinnules long and dense.

In one of the interradial areas there are three plates, one followed by two smaller ones; in two of the areas there are four plates in each, one followed by two in the second range and one in the third; and in the other area there are five plates, one followed by two in the second range and two in the third. There are seven azygous interradials, the first one heptagonal, in line with the first primary radials and of about the same size. It is followed by three plates, the central one being larger than the lateral ones; and these by two plates, in the third range, and one in the fourth, that is somewhat elongated and reaches the plates of the vault. Vault conoidal, and sub central proboscis smaller than in *B. Sampsoni*.

This species will be distinguished by the arrangement of its thirty-two arms from all other species. The same tendency of the arms to flatten near the upper ends has been discovered in other species of *Batocrinus* that has been overlooked by authors. But where the flattening is as slight as in our specimens of this species, it is probable that other specimens will not show any flattening, and that the character is not even of specific importance, and, moreover, it is probable that it does not exist in younger specimens, which would again tend to destroy its importance.

Found in the Keokuk Group, at Boonville, Missouri, and now in the collection of S. A. Miller.

BATOCRINUS INSUETUS, n. sp.

Plate I, Fig. 8, azygous view of calyx, vault, proboscis and part of the arms; Fig. 9, side view of same specimen.

Species rather below medium size. Calyx obconoidal, truncated below, about twice as wide as high; surface smooth or finely granular. Column medium size.

Basals form an hexagonal disc one half wider than the diameter of the column, with a central depression and rim around it, for the attachment of the column. First primary radials wider than high. Second primary radials quadrangular, short, two or more times as wide as high. Third primary radials a little larger than the second, twice as wide as high, pentagonal, axillary, and support on the upper sloping sides the secondary radials. In each lateral ray, the third primary radial supports, upon each upper sloping side, two secondary radials, the last of which is axillary and supports upon each upper sloping side a tertiary radial, that bears a single arm. There are, therefore, four arms in each of these rays. The distal side of each third primary radial adjoining the azygous area supports three secondary radials that bear a single arm; the proximal side of each supports two secondary radials, the last of which is axillary and supports upon each side a tertiary radial that bears a single arm. There are, therefore, three arms to each of these rays. In the ray opposite the azygous area, the third primary supports upon each upper sloping side three secondary radials, the last of which supports a single arm. There are, therefore, sixteen simple arms in this species and sixteen ambulacral openings to the vault. The arms are rather small and composed of a double series of interlocking plates that are slightly deeper than wide, in the lower part, but the arms flatten out near the superior ends, as they do in many other species in this genus. Pinnules long and dense.

There are three regular interradials in each area, one large, the other two small. There are four azygous interradials, one heptagonal, in line with the first primary radials and slightly larger and longer than either of them. It is followed by three plates, the middle one being the larger and longer, but it is cut off from the vault by the tertiary radials. The vault is highly convex, with a large proboscis that terminates in a balloon-shaped bulb, that has the azygous opening at one side of the summit. The plates of the vault are plain, or slightly convex, and smooth, but each plate, on the central and lower part of the balloon, bears a central tubercle, while the small plates on top and surrounding the orifice are smooth.

This species will be distinguished by the arrangement of its sixteen arms, by the four plates in the azygous area, and by the balloon-shaped proboscis. The shape of the vault and proboscis, in this genus, varies so much, that it may be doubtful about how far its form may be regarded as of even specific importance. We have among the species herein described the long slender proboscis extending beyond the arms, the balloon-shaped proboscis, with arms capable of spreading all over it, and the convex vault, without proboscis, save a swelling area like a recumbent proboscis, with the azygous orifice below the ambulacral canals. The breaking up of the genus *Batocrinus*, on characters, based on the vault, azygous orifice, and superior part of the arms, into subgenera or distinct generic names does not seem to be practicable or natural.

Found in the Keokuk Group, at Boonville, Missouri, and now in the collection of S. A. Miller.

BATOCRINUS BROADHEADI, n. sp.

Plate I, Fig. 10, basal view azygous side up; Fig. 11, view opposite the azygous area.

Species full medium size and among the larger forms with which it is associated. Calyx somewhat hemispherical, in general outline, rather more than twice as wide as high; radial series forming low, angular ridges from the basal plates to the free arms; interradial areas gently rounded; arm openings directed nearly horizontally; sutures distinct; surface granular.

Basals form an hexagonal disc that expands a little beyond the angles of the radial ridges, and has a diameter two and a half times the diameter of the column, and a hemispherical depression in the truncated surface below, for the attachment of the column. First primary radials twice as wide as long, longitudinally angular in the central part. Second primary radials quadrangular, and varying from one and a half to two and a half times as wide as long. Third primary radials pentagonal, larger than the second, wider than high, greatest width below the middle, at the angles formed by the junction of the lower expanding and upper sloping sides, axillary, and supporting on each upper sloping side the secondary radials. In the ray on the right of the azygous area, and in each lateral ray, there are two secondary radials, the second one of which is axillary, and bears upon each superior side two tertiary radials, which gives four arms to each of these three rays. In the ray on the left of the azygous area, there are two secondary radials, in the proximal series, the second one of which is axillary, and bears upon the proximal side two tertiary radials, and on the distal side one large tertiary radial, and in the distal series there are two secondary radials only, the last one being quite large. This gives to this ray three arms. In the ray opposite the azygous area the third primary radial bears upon each superior sloping side three secondary radials, which gives to this ray two arms. There are, therefore, seventeen arm openings to the vault in this species.

In the regular interradial area, between the three and four armed rays, there are only three plates, one very large followed by two elongated plates, one of which extends higher than the other. In each of the other three regular interradial areas there are four plates, one large plate, followed by two in the second range and one in the third. The azygous area is subovate in outline and contains nine plates. The first one is in line with the first radials, but smaller and narrower; it is followed by three much larger plates in the second range, and these by three in the third range, which are supported on two of the plates of the second range. Above the middle one in the third range there is a small plate, and between its right superior sloping side and the left superior side of the upper plate, in the third range, an elongated plate is supported that extends its superior angle between the second tertiary radials and unites with the plates of the vault.

Vault conoidal, slightly depressed in the interradial areas, and covered with rather large, polygonal, convex plates. Two small ovarian (?) apertures may be distinguished between the ambulacral openings in the azygous area; they are above the tertiary radials, at the angles between the two vault plates, in the azygous depression, and the smaller plate at each side of the ambulacral canals. Proboscis unknown.

Found in the Keokuk Group at Boonville, Missouri, and now in the collection of S. A. Miller. The specific name is in honor of Prof. G. C. Broadhead, formerly State Geologist of Missouri, a gentleman of high scientific attainments, whose professional skill and untiring energy has to such a great extent contributed to our knowledge of the geology, as well as to the wonderful development of the mining and economical industries of that state.

BATOCRINUS NITIDULUS, n. sp.

Plate I, Fig. 12, azygous view of calyx and vault; Fig. 13, opposite view of same.

We have four specimens of this species of the same size and in the same state of preservation as the one illustrated. None of them show any of the arms.

Species below medium size. Calyx broadly truncated below and obconoidal above, or like the frustum of a cone; one-half wider than high. Plates convex, usually bearing a transverse angular ridge, and beveled from the central part to the sutures. No radial ridges. Column small and having a very small, round, columnar canal.

Basals form an hexagonal disc nearly twice as wide as the diameter of the column and having a height less than half the diameter of the column. First primary radials wider than high. Second primary radials quadrangular, about three times as wide as high. Third primary radials vary from pentagonal to heptagonal depending upon the number of interradials that each side abuts against, and they vary somewhat in size, but are about twice as large as the second radials, axillary, and support on each upper sloping side two secondary radials, the last one of which is axillary and supports on each upper sloping side a single tertiary radial. There are, therefore, four arm openings to the vault from each ray or twenty ambulacral openings to the vault. The probability is that the arms did not bifurcate and that the species had only twenty arms.

There are three regular interradials, in each area, one large the other two smaller and somewhat elongated, in the speci men illustrated; but in other specimens in some of the areas, there are only two plates, one following the other. There are eight azygous interradials in the specimen illustrated, the first one heptagonal, in line with the first primary radials and of about the same size. It is followed by three plates, the middle one being the smaller, and these are followed by four smaller plates that are cut off from the vault by the union of the tertiary radials. In some of the other specimens, there are only three plates in the third range and, hence, only seven azygous plates. The vault is conoidal, covered with convex plates and bears an almost central proboscis.

This species is distinguished by its trim, neat form, beveled plates and twenty ambulacral openings to the vault. This is one of the forms that might be referred to *Eretmocrinus*, if that were a valid genus.

Found in the Keokuk Group, at Boonville, Mo., and now in the collection of S. A. Miller.

BATOCRINUS PECULIARIS, n. sp.

Plate I, Fig. 14, azygous side view; Fig. 15, basal view; Fig. 16, summit view of the same specimen.

Species below medium size. Calyx somewhat obconoidal, but spreading upward canopy-like, and directing the ambulacral openings horizontally. Truncated nearly three times the diameter of the column; plates moderately convex; sutures plain; surface granular. Column small; canal cinque foil.

Basals form an hexagonal disc nearly three times the diameter of the column, concave centrally below for the attachment of the column, and having a height equal to about half the diameter of the column. First primary radials wider than high. Second primary radials quadrangular, three times as wide as high. Third primary radials pentagonal, larger than the second, nearly three times as wide as high, axillary and support on the upper sloping sides the secondary radials. On the distal side of each ray adjoining the azygous area there are three secondary radials, and on the proximal side two secondary radials, the last of which is axillary and bears upon each upper slopping side two tertiary radials, which gives to each of these rays three arms. One of the lateral rays is constructed in like manner and bears three arms. The other lateral ray bears upon each of the upper sides of the third primary radial two secondary radials, the last being axillary and supporting on each upper sloping side two tertiary radials, which gives to this ray four arms. In the ray opposite the azygous area there are three secondary radials, which gives to this ray two arms. There are, therefore, fifteen arms in this species, as shown by the ambulacral openings to the vault.

There are three regular interradials in each area, one large, the other two small and somewhat elongated. The azygous area is very peculiar, as the proboscis having the azygous orifice separates the tertiary radials and projects below the ambulacral openings and occupies nearly half the azygous area. The first plate is heptagonal, in line with the first primary radials and the largest plate in the body. There are three plates in the second range, the middle one being the smaller and supporting the plates that surround the azygous orifice. In the third range, on one side of the recumbent proboscis or azygous ridge, there is one rather large plate, and all the other plates in the area are small and form part of the round recumbent proboscis. The vault is highly convex, and has a capacity equal to or greater than that of the calyx. It is covered with small, convex, polygonal plates. Upon the azygous side of the center a convex elevation arises that becomes more defined as it passes down between the ambulacral orifices and finally projects, like the end of a proboscis, below the arms in the upper third of the azygous area. It appears like the recumbent proboscis in *Siphonocrinus armosus*, though not projecting quite as much. Probably the word "proboscis" should not be used in the definition, for it is merely a rounded ridge from one side of the vault that terminates in a hemispherical projection that bears an orifice in the upper part of the azygous area, as shown in the illustration.

This species is distinguished by its general form, convex vault, recumbent proboscis with orifice below the arms, and by its fifteen arms, from all other species. By some it might be referred to *Dorycrinus*, but we think it is clearly a *Batocrinus*. Found in the Keokuk Group, at Boonville, Missouri, and now in the collection of S. A. Miller.

BATOCRINUS IMPARILIS, n. sp.

Plate I, Fig. 17, azygous view; Fig. 18, opposite azygous side

We have several specimens of this species varying from half the size of the one illustrated to about one-fourth larger. None of them show any of the arms, and the one illustrated is best preserved.

Calyx urn-shaped; about one-fourth wider than high, though sometimes nearly as high as wide. Plates tumid; no radial ridges; sutures distinct; column small; surface granular.

Basals form a very low hexagonal cup about three times as wide as the diameter of the column. The columnar facet is round, deep and preserves the serrated lines for the attachment of the column. The convexity of the plates extends below the point of attachment of the column. The first primary radials are much larger than any other plates in the body and have a height nearly equaling the width. Second primary radials quadrangular, about twice as wide as high. Third primary radials very little larger than the second, pentagonal, axillary, and support on each upper sloping side of three rays two secondary radials, which gives to each of these rays two arms. Each third primary radial adjoining the azygous area bears upon the distal upper side two secondary radials, the last one bearing a single arm, and upon the proximal side two secondary radials the last of which is axillary and bears upon each upper sloping side a single tertiary radial which gives to each of these rays three arms. There are, therefore, twelve arm openings to the vault in this species.

There are three regular interradials in each area, one large, the other two smaller, somewhat elongated, and unite with the plates of the vault. The azygous area is large. The first plate is in line with the first primary radials and of about the same size. It is followed by three rather large plates, in the second range, and these, by three small plates, in the third range, that unite with three plates that separate the arms and unite with the plates of the vault. The vault is convex and covered with convex polygonal plates. The proboscis is small and subcentral, but it is broken off close to the vault in all our specimens.

This species is distinguished by its general form, convex plates, union of interradials with the plates of the vault, and by having twelve arms. It cannot be mistaken for any other described species.

Found by R. A. Blair, in the Burlington Group, at Sedalia, Missouri, and now in the collection of S. A. Miller.

BATOCRINUS INCULTUS, n. sp.

Plate I, Fig. 19; azygous view; Fig. 20, opposite azygous side.

We have four specimens which we refer to this species, though there is some difference in the azygous areas. None of them show any arms. Species below medium size. Calyx urn-shaped and nearly as high as wide. Plates highly convex; no radial ridges; sutures distinct. Column round, rather large and having a cinque foil canal.

Basals form an elevated hexagonal cup about twice as wide as the diameter of the column and having an hemispherical depression below, for the insertion of the column. The first primary radials are the largest plates in the body, except the first azygous plate, and have a height nearly equal to the width. Second primary radials, quadrangular, and about or less than one-half wider than high. Third primary radials considerably larger than the second, and pentagonal or hexagonal, depending on the number of plates they abut upon, in the interradial areas, axillary, and support on each of the superior lateral sides two secondary radials, each of which bears a single arm. There are, therefore, ten arm openings to the vault, in this species.

The regular interradial areas are elongated and generally have four plates, but sometimes only three. There is one in the first range, generally two elongated plates in the second range, but sometimes only one, and one elongated plate in the third range that connects with the plates of the vault. The azygous area is large, and the number of plates is not uniform. The first plate is in line with the first primary radials and fully as large as any of them. It is followed, in the specimen illustrated, in the second range, by four plates, but, in other specimens, there are only three. Above these, in the specimen illustrated, there are three plates, followed by two plates that connect with the plates of the vault, but in other specimens only three or four plates can be distinguished.

The vault is convex and is covered by a few large convex plates, and bears a large subcentral proboscis, which is surrounded, near the base, by large convex plates.

This species bears some resemblance to *B. imparilis*, above described, but the calyx is more elongated, the vault and proboscis are altogether different, and it has only ten arms, while that species has twelve. When compared with other described species the differences are equally as well defined. We may here call attention to the fact, that the number of plates in the azygous and regular interradial areas, in the genus *Batocrinus*, is of less importance than the number of ambulacral openings to the vault, not only as shown by this species, but as shown by many others, in our possession.

Found by R. A. Blair, in the Burlington Group, at Sedalia, Missouri, and now in the collection of S. A. Miller.

BATOCRINUS INSPERATUS, n. sp.

Plate I, Fig. 21, azygous view; Fig. 22, opposite azygous side.

This species is founded upon a single specimen, that seems to be perfect in all its parts, and, if abnormal, we do not know from what parents it arose. The calyx and vault together have a sub-elliptical outline with both ends slightly truncated. Species below medium size. Calyx urn-shaped, about as high as wide. Plates tumid; no radial ridges; sutures distinct; surface granular. Column round and small. It has, however, only four radial series.

Basals form an elevated hexagonal cup, about twice as wide as the diameter of the column, and having, the plates rounded below to a hemispherical depression for the insertion of the column. First primary radials wider than high and of unequal size, though there are only four of them. Second primary radials quadrangular, and nearly as long as wide. Third primary radials considerably larger than the second, three hexagonal and one heptagonal, axillary, and support on each of the superior sloping sides two secondary radials, each of which bears a single arm. There are, therefore, eight arm openings to the vault in this species.

The first regular interradials are large, tumid plates, and, in one of the areas, the first one is followed by two elongated plates, that unite with two plates belonging to the vault, but, in the other two areas, the first one is followed by two plates in the second range and two smaller ones in the third range, that connect with two plates belonging to the vault. The first azygous plate is in line with the first primary radials, very tumid, and rather larger than either of them. It is followed by three plates in the second range, and these by two in the third range, that unite with the plates of the vault. The vault is elevated over the ambulacral canals, conical, and bears a large central proboscis, which is broken off in our specimen. The plates on the vault are polygonal, tumid and few in number.

This species cannot be compared with any other, unless it is for the purpose of showing that it is abnormal, and not entitled to a specific name It is four-fifths of a *Batocrinus*. It agrees with *Batocrinus* as far as it goes. The definition of *Batocrinus* requires five radial series, and this species has only four. The radial series that is missing is the one opposite the azygous area. Probably it will be found to be as near *B. incultus* as to any other species, but, aside from the four radial series, it will be noticed that the interradial and azygous areas and the vault and proboscis are quite different in the two species. Take from *B. incultus* one radial series and one interradial area and close up the opening, it will be found to be widely different from this species in general form and outline. The differences are even more marked when compared with *B. imparilis*, which has twelve ambulacral openings. We see no reason why a crinoid should not have perpetuated itself while having only four radial series as well as if it had six. The difficulty that is hard to overcome in this case is, if we have here a good species, we ought also to have a good genus, and yet we are unwilling to take it out of the genus *Batocrinus*. If our specimen is abnormal, it is well worth defining and illustrating, and the specific name we have given it will serve for a handle until some one has ascertained to what species it should be referred, and even then the synonymy will not have altogether lost its usefulness. We are of the opinion that our specimen descended from a *Batocrinus*, and, if we had two specimens, we would be confident that it could perpetuate itself and, therefore, rank as a species; but, if the single specimen is all that ever existed, we would say it is abnormal, and only proves the great vitality the species possessed, that gave it the strength to grow to maturity in the perfect form of its kind, while one-fifth of the body was absent from its birth or inception. Under all the circumstances, probably, the specific name should be received only provisionally.

Found in the Burlington Group, at Sedalia, Missouri, and now in the collection of S. A. Miller.

BATOCRINUS FORMACEUS, n. sp.

Plate I, Fig. 23, azygous view; Fig. 24, opposite view.

Species medium or above medium size. Calyx bowl-shaped, semi-elliptical, broadly rounded below; height two-thirds the diameter; no radial ridges; sutures distinct, not beveled; surface granular. Column small, round.

Basals form an hexagonal disc about twice as wide as the diameter of the column with an hemispherical columnar cavity radiately furrowed. First radials large, expanded, three hexagonal and two heptagonal. Second radials, quadrangular, a little wider than long. Third radials one-half larger than the second, pentagonal, except the one upon the left of the azygous area, which is hexagonal, and three of the rays support upon each upper sloping side two secondary radials, the last of which is axillary and supports upon each upper sloping side two tertiary radials which gives to each of these rays four arms. In one of the lateral rays there are upon one side three secondary radials and upon the other two secondary radials, the last being axillary and supporting upon each upper sloping side two tertiary radials, which gives to this ray three arms. In the ray opposite the azygous area the third primary radial supports, upon each superior side, three secondary radials, which gives to this ray two arms. There are, therefore, seventeen arm openings to the vault in this species.

The regular areas do not connect with the vault, except in the area between the two and three-armed rays and the number of plates in each varies from three to five. The azygous area is very large and contains fifteen plates. The first one is in line with the first primary radials and of the same size. It is followed by three plates in the second range, five plates in the third range, three in the fourth range and above these there are three plates two of which connect with the plates of the vault. Vault convex, composed of polygonal, convex plates and bears a strong subcentral proboscis.

This species is distinguished by its general form, absence of radial ridges, and seventeen ambulacral openings to the vault. It will also be distinguished by the number of plates in the azygous area, if that feature is of specific importance, but we have known the number of plates, in the azygous area, to vary, among specimens, that we have referred to the same species, and, probably, in this species some specimens may show a less number of plates, commencing with the five plates in the third range and continuing to the vault. We have seen two specimens besides the one illustrated, but the plates in the upper part of the azygous area are either not well preserved or are not to be distinguished from the type.

Found in the Burlington Group, at Sedalia, Missouri, and now in the collection S. A. Miller.

BATOCRINUS INCONSUETUS, n. sp.

Plate I, Fig. 25, basal view; Fig. 26, summit view; Fig. 27, azygous side view.

Species medium or below medium size. Calyx very low and saucer-shaped; height not more than one-fourth the diameter, and ambulacral openings directed horizontally; slight radial ridges, interradials plain; surface smooth. Column medium size and round.

Basals form a circular disc that projects below the first primary radials about the thickness of a plate, has a diameter about twice as great as the diameter of the column, and bears a concave, radiately lined depression for the columnar attachment. First primary radicals twice as wide as long, three hexagonal and two heptagonal. Second primary radials quadrangular, about three times as wide as long. Third primary radials a little larger than the second, twice as wide as long, pentagonal, axillary and in each lateral ray support upon each upper sloping side two secondary radials, the last of which is axillary and supports upon each upper side two tertiary radials which gives to each of these rays four arms. Upon the distal side of the third primary radials adjoining the azygous area there are four secondary radials, and on the proximal side two secondary radials, the last of which is axillary and bears upon the distal side two tertiary radials, and upon the proximal side three tertiary radials which arrangement gives to each of these rays three arms. In the ray opposite the azygous area there are three secondary radials upon each side of the third primary which gives to this ray two arms. There are, therefore, sixteen ambulacral openings to the vault in this species, and the last radials are small and contracted which makes it probable that the arms, which are not preserved, are single and not large.

There are three regular interradials in each area, one followed by two in the second range that are short and enclosed below the tertiary radials so that they do not approach the vault. The first azygous plate is in line with the first primary radials and somewhat longer, and it is followed, in the second range, by four plates that very much widen the lower part of the area. There are four plates in the third range and these are followed by a single narrow elongated plate that connects with the plates of the vault.

The vault is low and has about the same capacity as the calyx. It is covered with polygonal, convex plates and bears a small subcentral proboscis. The ovarian apertures are conspicuous in this species. There are two between each pair of arms and one between the secondary and tertiary series in the three-armed rays, which makes sixteen in the species. They are above the calyx and connect with the ambulacral canals under the vault.

This species is distinguished by its general form, sixteen arms, four azygous plates in the second range, short regular interradial areas, and ovarian apertures. It cannot be mistaken for any other described species.

Found by S. A. Miller in the Keokuk Group, at Boonville, Missouri, and now in his collection.

BATOCRINUS SERRATUS, n. sp.

Plate I, Fig. 28, basal view; Fig. 29, azygous side view; Fig. 30, summit view.

Species medium or below medium size, the one illustrated is the largest among four which are before us. Calyx nearly flat; height one-fifth or one-sixth the diameter, and ambulacral openings directed horizontally; radial series project at the margin so as to notch the circumference at the interradial parts, and they are somewhat lobed, without radial ridges; surface granular. Column round, medium size.

Basals form a subhexagonal disc, that projects below the first primary radials about the thickness of a plate, has a diameter about one-half greater than the diameter of the column, and bears a slight concave, radiately lined depression, for the columnar attachment. First primary radials twice as wide as long, three hexagonal, two heptagonal. Second primary radials quadrangular and from two to three times as wide as long. Third primary radials a little larger than the second, twice as wide as long, pentagonal, axillary and in each lateral ray support upon each upper sloping side two secondary radials, the last of which is axillary and supports upon each upper sloping side two tertiary radials, which gives to each of these rays four arms. Upon the distal side of the third primary radials adjoining the azygous area there are three secondary radials, and on the proximal side, two secondary radials, the last of which are axillary and bear upon each superior sloping side two tertiary radials which gives to each of these rays three arms. In the ray opposite the azygous area there are three secondary radials upon each side of the third primary radial, which gives to this ray two arms. There are, therefore, sixteen ambulacral openings to the vault in this species.

The regular interradial areas are elongated and not uniform. In two of the areas one large plate is followed by one short small plate and one elongated plate that unites with two plates belonging to the vault. In another area there are two plates corresponding to the elongated plate just mentioned, and the last one unites with the plates of the vault, and in the other area there are only two plates, one following the other, and they are cut off by the third radials from uniting with the plates of the vault. The first azygous plate is in line with the first primary radials and somewhat smaller; it is followed by three plates in the second range and two in the third range, that unite with the plates of the vault.

The vault, though low, has more capacity than the calyx. It is covered with polygonal, convex plates and bears a small subcentral proboscis. The ambulacral areas are convex and the interambulacral areas abruptly depressed at the interradial areas, so that the vault presents the same notched margin that belongs to the calyx. There are sixteen ovarian apertures, but they are small and situated close to the ambulacral openings and not as far back upon the vault as in *B. inconsuetus*.

This species when compared with *B. inconsuetus*, that has the same number of arms, will be found to have quite different interradial and azygous areas and fewer plates in them; there are fewer tertiary radials in the rays, and the lobed rays and depressed marginal interradial areas serve at once to distinguish it, without touching upon minor differences, that will occur to any one who reads the descriptions. It is so different from all other described species that no comparison with any of them is necessary.

Found by S. A. Miller in the Keokuk Group, at Booneville, Missouri, and now in his collection.

BATOCRINUS IGNOTUS, n. sp.

Plate I, Fig. 31, basal view; Fig. 32, azygous side viuw; Fig. 33, summit view.

Species medium size. Calyx low, three times as wide as high and ambulacral openings directed horizontally. Radial series rounded, most strongly convex at the margin; interradial areas slightly concave, surface granular; column round, medium size.

Basals form a subhexagonal disc that projects below the first primary radials and has a diameter about twice as great as the diameter of the column; it bears a moderately concave, radiately lined depression for the columnar attachment. First primary radials of unequal size and a little wider than long, three hexagonal, two heptagonal. Second primary radials quadrangular and about three times as wide as long. Third primary radials larger than the second, more than twice as wide as long, pentagonal, axillary, and in one lateral ray supports upon each upper sloping side two secondary radials, the last being axillary and supporting upon each upper sloping side two tertiary radials; in the other lateral ray there are three secondary radials, on each side of the third primary radial, the last of which are axillary and bear upon each superior side two tertiary radials, which gives to each of these rays four arms. Upon the distal side of the third primary radials, adjoining the azygous area there are three secondary radials, and on the proximal side two secondary radials the last of which are axillary and bear upon each superior sloping side two tertiary radials, which gives to each of these rays three arms. In the ray opposite the azygous area the third primary radial bears upon one side three secondary radials and upon the other two secondary radials, the last being axillary and supporting upon each upper side two tertiary radials, which gives to this arm three rays. It will be observed that this ray is constructed in the same way that the rays are on each side of the azygous area and that the side having three secondary radials is on the side of the lateral ray that has three secondary radials on each side of the third primary radial. This species, therefore, has seventeen ambulacral openings to the vault.

There are three regular interradials in cach area; one large plate followed by two small ones. They are below the tertiary radials and do not reach near the vault. There are six plates in the azygous area. The first one is in line with the first primary radials and about the same size; it is followed by three plates in the second range, and two in the third, neither of which approaches the vault.

The vault is highly convex and has more capacity than the calyx. It is covered with plain, polygonal plates, and bears a rather large proboscis. The ovarian apertures are small and on the sides of the plates surrounding the ambulacral canals. There appear to be seventeen of them.

This species is distinguished by its general form and seventeen arms. If the three secondary radials, in one of the lateral rays, is to be regarded as a normal feature, then that alone will distinguish it from all other species. If we had two specimens of this species possessing three secondary radials, we would not hesitate to regard it as a normal feature, but having only one, it may be a strange freak that was not perpetuated.

Found by S. A. Miller in the Keokuk Group, at Boonville, Missouri, and now in his collection.

BATOCRINUS MODESTUS, n. sp.

Plate I, Fig. 34, basal view; Fig. 35, azygous side view; Fig. 36, summit view.

Species medium or just below medium size. Calyx subhemispherical, rather more than twice as wide as high, and broadly rounded below. Plates convex. No radial ridges. Surface granular. Column round, medium size.

Basals form an hexagonal disc that projects slightly below the first primary radials and has a diameter a little less than twice the diameter of the column; it bears a moderately concave, radiately lined depression for the columnar attachment. First primary radials about one-half wider than high, three hexagonal, two heptagonal. Second primany radials quadrangular, three or four times as wide as long. Third primary radials only a little longer than the second, and two or three times as wide as long, pentagonal, axillary, and in one lateral ray supports upon each upper sloping side two secondary radials, the last one of which is axillary and supports upon each upper sloping side two tertiary radials, which gives to this ray four arms. In the other lateral ray there are four secondary radials upon one side of the third primary radial and two upon the other followed by three tertiary radials upon each side, which gives to this ray three arms. Upon the distal side of the third primary radials adjoining the azygous area there are four secondary radials and on the proximal side two, the last being axillary and bearing upon each upper sloping side two or three tertiary radials which gives to each of these rays three arms. In the ray opposite the azygous area there are three secondary radials on each upper sloping side which gives to this ray two arms. There are, therefore, fifteen arm openings to the vault, in this species, but all the arms preserved in any of our specimens at once bifurcate, giving, as indicated, thirty free arms to the species. We have, however, only three specimens showing any of the arms, but one of them has five bifurcating rays showing part of ten arms. The general form and parts preserved leave little doubt that the species has thirty free arms.

There are three regular interradials in each area—one large plate followed by two small ones. They are below the tertiary radials and do not reach the vault. There are seven plates in the azygous area. The first one is in line with the first primary radials and of about the same size; it is followed by three plates in the second range, two in the third range and one in the fourth, which unites with the plates of the vault.

The vault is conoidal and has a capacity about equal to that of the calyx. It is covered with plain and slightly convex, polygonal plates, and bears a moderate-sized subcentral proboscis. No ovarian pores have been seen in any of our specimens and there appears to be no evidence of their existence.

This species is distinguished by its general form, hemispherical calyx and conoidal vault, fifteen ambulacral openings to the vault and thirty free arms. Any one capable of distinguishing a *Batocrinus* will at once know the species from these peculiarities.

Found by S. A. Miller, in the Keokuk Group, at Boonville, Missouri, and now in his collection.

BATOCRINUS HETEROCLITUS, n. sp.

Plate I*, *Fig.* 37, *basal view; Fig.* 38, *azygous side; Fig.* 39, *summit view.

Species rather below medium size. Calyx and vault subequal, and together somewhat trochiform. Height of the calyx about one-third the diameter, and ambulacral openings directed horizontally. Radial series project at the margin, so as to notch the circumference at the interradial parts. Radial ridges well defined and angular. Surface granular. Column round and small.

Basals form an hexagonal disc or very low cup two and a half times the diameter of the column. First primary radials wider than long, three hexagonal, two heptagonal. Second primary radials quadrangular, and from two to three times as wide as long. Third primary radials only a little larger than the second, twice as wide as long, pentagonal, axillary, and in each lateral ray, and in the ray on the right of the azygous area support upon each upper sloping side two secondary radials, the last of which are axillary and support upon each upper sloping side two tertiary radials, which gives to each of these three rays four arms. The ray on the left of the azygous area bears on the distal side of the third primary radial three secondary radials, and on the proximal side two secondary radials, the last one being axillary and supporting, on each upper sloping side, a single tertiary radial, which gives to this ray three arms. The ray opposite the azygous area bears upon each upper side three secondary radials, which give to it two arms. There are, therefore, seventeen arm openings to the vault in this species.

The regular interradial areas are elongated and connected with the vault. The first plate is smaller than a first radial; it is followed by two plates in the second range, and, in some areas, with two plates in the third range that connect with the plates of the vault, and, in other areas, one plate in the third range connects with the plates of the vault. There are, therefore, four plates in some areas and five in other areas. The azygous area is large and connected with the plates of the vault. The first azygous plate is in line with the first primary radials and somewhat narrower; it is followed by three large plates in the second range, three smaller ones in the third range, and two in the fourth range, that connect with the plates of the vault. There are, therefore, nine plates in this area.

The vault is conoidal, low, depressed toward the margin in the interradial areas, and covered with polygonal, convex plates. There is doubt about the presence of a proboscis. The highest elevation is almost central and if a proboscis existed it must have been very small, for, at that place, the plates indicate a small orifice, without the upright plates that support a proboscis. We think no proboscis existed, in this species, and, therefore, we think, in *Batocrinus*, all the variations may exist on the vault, from no proboscis at all, to the balloon-shaped or to the most elongated and crooked forms that have been called *Eretmocrinus*. A few ovarian apertures may be distinguished, but they are very minute, and, adjoining some of the arms, there seems to be none at all; in fact, there are only two, one on each side of the azygous depression, that can be clearly distinguished.

This species will be distinguished, by its general form, connection of the interradial area with the vault, and by the seventeen ambulacral openings. The entire absence of a proboscis or the existence of a very short one is a feature also of some importance.

Found by S. A. Miller in the Keokuk Group, at Boonville, Missouri, and now in his collection.

BATOCRINUS PROCERUS, n. sp.

Plate I, Fig. 40, basal view; Fig. 41, azygous side view; Fig. 42, opposite view of same specimen.

Species medium size and capacity of the vault exceeding that of the calyx and belonging to those forms which are referred by authors to *Eretmocrinus.* Calyx broadly truncated below and obconoidal above, for a short distance, but becoming obpyramidal, in the region of the arms, by reason of a slight tendency toward lobes, in the radial series. No radial ridges. Width about one-half more than height. Plates moderately convex. Column round—not large.

Basals form an hexagonal disc more than one-half wider than the diameter of the column, with a concave, radiately lined depression below, for the columnar attachment. First primary radials wider than high. Second primary radials quadrangular, from two to three times as wide as high. Third primary radials about one-half larger than the second, more than twice as wide as long, pentagonal, axillary, and, in each series, except the one opposite the azygous area, bear upon each upper sloping side two secondary radials, the last one of which is axillary and supports upon each superior sloping side a single tertiary radial, which gives to each of these four rays four arms. In the ray opposite the azygous area there are, upon one of the superior sloping sides of the third primary radial, three secondary radials and upon the other two secondary radials, the last of which is axillary and bears upon each upper side, a single tertiary radial, which gives to this ray three arms. There are, therefore, nineteen arms in this species.

There are three regular interradials, in each area, one large followed by two smaller ones, below the tertiary radials, which abut against each other and cut off the area from any connection with the vault. There are seven plates in the azygous area. The first one in the line with the first primary radials and somewhat narrower; it is followed by three plates in the second range and two in the third and above these one plate that unites with the plates of the vault, as it appears in our specimen. Our specimen, however, is slightly injured about the top of this plate, so as to leave the sutures in doubt, and possibly an angle from the tertiary radials may separate it from the plates of the vault.

The vault is somewhat pyramidal in the lower part and conoidal above. On the azygous side there is a longitudinal, concave depression extending down to the azygous area of the calyx. The vault is covered with slightly convex, polygonal plates. The proboscis is large and central. There are no ovarian pores.

This species is distinguished by its general form and nineteen ambulacral openings to the vault. It is unnecessary to compare it with any other species that possessed the same number of ambulacral openings.

Found by S. A. Miller, in the Keokuk Group, at Boonville, Missouri, and now in his collection.

BATOCRINUS VICINUS, n. sp.

Plate II, Fig. 1, basal view; Fig. 2, azygous side view; Fig. 3, summit view.

Species below medium size, vault rather larger than the calyx, but, on the whole, somewhat trochiform. Height of the calyx less than half the diameter, and ambulacral openings directed horizontally. Radial series project at the margin so as to notch the circumference at the interradial parts. Radial ridges moderately well defined and angular. Surface, granular. Column round and small.

Basals form an hexagonal disc about one-half wider than the diameter of the column, and which extends, in a low rim, below the first radials. First primary radials wider than long, three hexagonal, two heptagonal. Second primary radials quadrangular, and about twice as wide as long. Third primary radials about twice as large as the second, and about twice as wide as long, pentagonal, axillary, and each one, adjoining the azygous area, bears on the distal side two secondary radials and on the proximal side two secondary radials, the last being axillary and supporting upon each upper side a single tertiary radial which gives to each of these rays three arms. Each lateral ray is constructed in the same manner and each bear three arms. In the ray opposite the azygous side the third primary radial bears upon each upper sloping side three secondary radials, which gives to this ray two arms. There are, therefore, fourteen arms in this species.

The interradial areas are elongated and the plates connect with those of the vault. The first plate is about the size of a first primary radial; it is followed by two small plates in the second range, and one or two in the third range, and these by one or two that connect with the plates of the vault. There are, in these areas, from five to seven plates. The azygous area is large and contains twelve plates. The first one is in line with the first primary radials and of about the same size; it is followed by three plates in the second range, four in the third range, and four in the fourth range, three of which connect with the plates of the vault.

The vault is highly convex centrally and depressed toward the margin, in the interradial areas, and covered with polygonal convex plates. A large plate occupies the central part of the vault, and adjoining it on the azygous side is a small azygous orifice directed upward. There is no proboscis, though the plates surrounding the orifice are elevated higher than the central plate. There are no ovarian apertures.

This species is distinguished by its general form and fourteen arms from all other species. By some it will be classed in the genus *Dorycrinus*, but we are not inclined to extend the genus *Dorycrinus* to include such species as this, for by so doing it will graduate into *Balocrinus*. In *Dorycrinus* there are large plates bearing spines on the vault, and the azygous area is altogether different from the regular interradial areas, and the orifice is directed laterally from a more or less bulbous protuberance, neither of which characters exist in this species. It is true, however, that, in some respects, this species is allied to *Dorycrinus*, and is widely different from the most typical *Batocrinus* in some respects, but the essential characters enable us, without hesitation, to refer it to the latter genus.

Found in the Keokuk Group, at Booneville, Missouri, and now in the collection of S. A. Miller.

BATOCRINUS INOPINATUS, n. sp.

Plate II, Fig. 4, basal view; Fig. 5, azygous side; Fig. 6, summit view.

Species below medium size. Calyx short, obconoidal, diameter more than twice the height. Radial ridges present, but not very well defined. Surface granular. Column round and quite small.

Basals form an hexagonal disc or very low cup that bears a rim below the first primary radials, and has a diameter about twice as great as the diameter of the column. First primary radials a little wider than long, three hexagonal, two heptagonal. Second primary radials, quadrangular, very short, between two and three times as wide as long. Third primary radials one-half larger than the second, three pentagonal, two hexagonal, axillary, and each one adjoining the azygous area bears, on the distal side, two secondary radials, and one of them bears, on the proximal side, a single secondary radial which is axillary, and bears upon each upper sloping side a single tertiary radial, and the other one bears, on the proximal side, two secondary radials, the last one of which is axillary, and bears upon one upper sloping side two tertiary radials, and upon the other, one, giving to each of these rays three arms. One of the lateral rays bears upon one of the superior sloping sides of the third primary radial three secondary plates, and upon the other two secondary radials, the last of which is axillary, and bears upon each upper side a single tertiary radial, which gives to this ray three arms. In the other lateral ray the third primary radial bears upon each upper sloping side two secondary radials, the last being axillary, and bearing upon the proximal sides one tertiary radial, and upon the distal sides two tertiary radials, which gives to this ray four arms. In the ray opposite the azygous area the third primary radial bears upon each upper sloping side three secondary radials, which gives to this ray two arms. There are, therefore, fifteen arm openings to the vault in this species.

The interradial areas connect with the vault, but they differ in form and in the number of plates. The first plate is about as large as a first primary radial. It is followed in one of the areas by a single plate, in two of the areas by two plates, and in one of the areas by three plates in the second range. In the third range in each case a single elongated plate connects with the plates of the vault. The azygous area is large, and contains ten plates. The first one is in line with the first primary radials, and is followed by three large plates in the second range. One of the lateral plates, in the second range, supports two small plates, and, over the middle plate, in the second range, there are two ranges of two plates each, one of the larger of which connects with the plates of the vault.

The vault is nearly flat, covered with slightly convex, polygonal plates, and bears a small subcentral proboscis. No ovarian apertures can be distinguished.

This species is distinguished by its general form, flattened vault, peculiar interradial areas and fifteen arms.

Found by S. A. Miller, in the Keokuk Group, at Boonville, Missouri, and now in his collection.

BATOCRINUS PLANUS, n. sp.

Plate II, Fig. 11, basal view of a cast preserving elevated lines outlining the plates; Fig. 12, summit view of same specimen, but the outline of the plates is not preserved; Fig. 13, azygous side view of same; Fig. 14, basal view of another, perfectly preserving the plates, as far as illustrated.

Body very much depressed, pentagonal, capacity of the vault equal to or exceeding that of the calyx. Calyx very low, about four times as wide as high, concave in the region of the basals and gently rounding over the first radials toward the margin. Plates convex and radial ridges lobed above the first radials. Surface granular. There are pits at the angles of the larger plates in our specimen, but that character is not shown on either of two casts and may not, therefore, be normal. One cast is one-fourth larger than the specimen illustrated. It will be observed, that there is some difference, in the proportional size of the plates, and the depressions on the cast, this is because the internal sides of the plates are not like the external surface. It is for this reason, that we cannot always recognize the casts, when we are conversant with specimens having the plates well preserved, and it is, therefore, a matter of gratification to be able to illustrate a species preserved in both ways.

The basals form a small hexagonal, concave disc which is almost wholly covered with the column. The first radials are quite as long as wide and very slightly rounded from the basals to the second radials, three hexagonal, two heptagonal. Second radials quadrangular, about one and a half times as wide as long. Third radials one-half larger than the second, pentagonal, axillary and support upon each upper sloping side two secondary radials, the last of which are axillary and support the free arms. As near as can be ascertained, from our specimens, there are four arms in each series, which arise from the second secondary radials and are directed horizontally.

The interradial areas are wide and the plates connect with those on the vault. In each regular area there are three plates, one large followed by two elongated plates that unite with three plates belonging to the vault. There are seven azygous interradials, the first one heptagonal, in line with the first primary radials and of the same size. It is followed by three plates in the second range and three in the third range, which unite with four plates belonging to the vault. The vault is convex, and bears a subcentral azygous prominence, with the orifice on top, but whether or not there is a proboscis cannot be determined definitely from our specimens.

This species would be classed with *Steganocrinus* if it had hexagonal, second, primary radials. But, aside from the unusual, flattened, pentagonal outline, the calyx is that of a true *Batocrinus*. There is no species described in either genus, with which it is necessary to compare it.

Found by R. A. Blair, in the Burlington Group, at Sedalia, Missouri, and now in the collection of S. A. Miller.

BATOCRINUS PRODIGIALIS, n. sp.

Plate III, Fig. 4, basal view; Fig. 5, azygous side; Fig. 6, summit view.

Species very large and wonderfully strong, nearly four times as wide as high. Exceedingly rough, by reason of the plates being produced in wedge-shaped, transverse nodes. The radial series are prolonged beyond the interradial areas leaving the circumference deeply notched between the arms. Column round at the calyx, large and pierced by a round columnar canal.

Basals short, projecting in cuneiform edges and expanding below the end of the column, and beveled at the sutures, so as to give the base an hexagonal outline. The basal disc is about twice as wide as the diameter of the column. The circle for the attachment of the column is only slightly concave and is radiately furrowed at the margin. First radials full twice as wide as high, three hexagonal, two heptagonal. Second primary radials, less than half as large as the first, quadrangular, and more than twice as wide as long. Third primary radials a little larger than the second, short, pentagonal, axillary and support on each upper sloping side two secondary radials, the last of which is axillary and bears the tertiary radials. In each of the radial series, there is upon one of the upper sloping sides of the last secondary radial a single tertiary radial which is axillary and bears upon each upper side quaternary radials, which gives to each ray five arms. In each radial series there are three or four tertiary radials and where the last tertiary radial is axillary there are upon each upper sloping side three quarternary radials. There are, therefore, twenty-five ambulacral openings to the vault. They are all directed horizontally so as to leave deeply notched interradial areas that connect with the vault.

Interradial areas elongated and covered with four plates. The first one is large and nearly as long as wide; it is followed by two plates in the second range and one in the third that connects with the plates of the vault. In the azygous area there are twelve plates. The first one is in line with the first primary radials and somewhat smaller; it is followed, in the second range, by three plates, in the third range by four plates, and in the fourth range by four plates that connect with the plates of the vault. There is some irregularity in the last range of plates and two of them are elongated and in part belong to the vault. The fact is, that there is no line directly separating the plates of the calyx, in this area, from those belonging to the vault.

Vault abruptly convex on the azygous side and highly convex on the other, so that the vault has two or three times the capacity of the calyx. The vault is not depressed in the interradial areas, but carries its convexity full to the margin of the interradial areas of the calyx. It is covered with large polygonal nodose plates and bears a large, subcentral proboscis.

The expanded basals and large subcentral proboscis will cause it to be classed with *Eretmocrinus*, by many authors. The union of the interradial areas with the vault is not a common character of *Batocrinus*, but this is not a special character ascribed to *Eretmocrinus*, and if it were, still it is a character possessed by many species of *Batocrinus*. On the whole, the quadrangular second primary radials ally it with *Batocrinus* so strongly, that we have no hesitation in referring it to that genus. It is in striking contrast with the *Batocrinus* figured on Plate I of this Bulletin, and shows the wonderful development of this genus. This species is distinguished from *B. yandelli*, which it most resembles, by having twenty-five instead of twenty-one or twenty-two arm openings to the vault, and by having one more regular interradial in each area and one or two more azygous plates. The calyx is not as high, though it is a larger species.

Found by Geo. K. Greene, in the Keokuk Group, at Button Mould Knob, Kentucky, and now in the collection of Wm. F. E. Gurley.

SHUMARDOCRINUS, n. gen.

This genus is founded upon the species described by Shumard, under the name ef *Actinocrinus concinnus*, in the Geo. Sur. of Mo. for 1855, page 189, and illustrated on plate A, figure 5. The generic formula is as follows: Basals, 3. Radials, 2 by 5. Regular interradials, 1. Azygous interradials, 3. Interradial areas connect with the vault without any distinguishing line of separation. Azygous orifice subcentral. No proboscis. Type *Shumardocrinus concinnus*.

The specific description given below may embody generic characters, but as we have only one species belonging to the genus, it is not easy to distinguish characters that are specific from those that are generic; and, it is not improbable, that another species may be found having a proboscis, and, if so, the presence or absence of a proboscis will dwindle to specific importance only. We refer the genus to the *Actinocrinidæ.*

SHUMARDOCRINUS CONCINNUS, Shumard.

Plate II, Fig. 7, basal view; Fig. 8, summit view; some of the plates are destroyed; Fig. 9, side view; Fig. 10, azygous side view.

This species was described in 1855 by Shumard in these words:

"The portion of the body of this species situated above the second radial pieces is unknown.

"The inferior part of the calyx is nearly hemispherical, and the plates moderately thick. Basal pieces, three, nearly equal in size, forming a low cup with a nine-sided border, and presenting beneath a wide, circular, shallow depression for the column. First radials, moderately convex, length and breadth nearly equal, three hexagonal and two heptagonal; inferior angle of heptagonal pieces corresponding with a basal suture. Second radials, wider than long, with the articular facets for third radials nearly perpendicular, large, reniform, occupying nearly half the length and two-thirds the width of each piece. First interradials, hexagonal, a little longer than wide, and rather larger than the second radials. First areal pieces, hexagonal, longer than wide, its inferior angle corresponding to a basal suture. Second areals, heptagonal, surface of the plates ornamented with prominent radiating ridges, which rise from near the center of the plates, and cross the sutures, so as to form several sets of double triangles around the body."

It will be observed, that Shumard thought he had only a fragment of the calyx, whereas he had, in fact, a complete calyx. He thought he had an *Actinocrinus*, as far as the second radials, and that the third radials had been broken away, but he had a new genus that never had any third radials.

Meek and Worthen described *Actinocrinus validus*, in 1860, in proceedings Acad. Nat. Sci. Phil. p. 384; but in 1866, in vol. 2 of the Geo. Sur. Ill., p. 200, referred it to *Actinocrinus concinnus.* Their species has but little resemblance, in any respect, to Shumard's, and it is not easy to understand why the two were ever confounded with each other. *Actinocrinus validus* must be restored, as a species, and as it is not a typical *Actinocrinus*, but approaches *Steganocrinus*, to which genus it has been referred by some authors, it may be known as *Steganocrinus validus*, Meek and Worthen.

We would describe this species from a specimen found in the Burlington Group, at Sedalia, Missouri, and illustrated in this Bulletin, as follows:

Calyx and vault subequal in capacity. Calyx pentagonal, three or four times as wide as high. Plates pyramidal and radiately sculptured. Column small and round.

Basals three and forming an hexagonal sculptured disck. First radials about as long as wide, three hexagonal and two heptagonal. Second radials about as large as the first, hexagonal and notched on the superior side by the ambulacral furrow. The articulating facets described by Shumard for the third radials are the articulating facets for the first plate in the free arms.

The first regular interradial hexagonal, smaller than the radials and succeeded by two smaller plates that abut upon the second radials and upon the ambulacral furrows and unite with three plates on the vault. The first azygous plate is in line with the first radials and of about the same size. It is followed by two plates, each of which is about the size of the first regular interradials. These plates abut the first plate on the sides of the ambulacral furrows, and are followed by three plates belonging to the vault.

The vault is convex and covered with highly convex and conical, polygonal plates. The azygous orifice is rather large and subcentral. The arms are unknown.

Found by R. A. Blair in the Burlington Group, at Sedalia, Missouri, and now in the collection of S. A. Miller.

MEGISTOCRINUS ORNATUS, n. sp.

Plate II, Fig. 15, basal view azygous side up; Fig. 16, azygous side view; Fig. 17, summit view.

Species medium or above medium size. Calyx subhemispherical, a little concave below, about twice as wide as high, not constricted below the arms. Surface delicately and ra diately sculptured from the central part of each plate, but without any central nodes or other elevations. Arm openings directed upward at an angle of about forty-five degrees. Column round, rather large and having a large, slightly cinque-foil canal.

Basal plates form an hexagonal disc about one-third wider than the diameter of the column. The first primary radials are the largest plates in the calyx, slightly unequal in size, not visible in a side view, those abutting on a single basal are heptagonal. The second primary radials are hexagonal, wider than long, differ somewhat in size, but smaller than the first. The third primary radials are slightly smaller than the second, the two adjoining the azygous are hexagonal, the other three are heptagonal. They are all axillary and bear the secondary radials. There is a single secondary radial on each upper sloping side of the third primary radials in the two rays adjoining the azygous area and in the ray opposite thereto. Each of these secondary radials are axillary and bear upon each superior sloping side two tertiary radials which gives to each of these three rays four arms. In the two lateral rays there are three secondary radials in each series which gives to each of these rays two arms. This arrangement gives to the species sixteen arms.

In each of the intersecondary areas that separate the three four armed series there are two plates, one following the other, the second one unites with the plates of the vault which throws the arms together in eight pairs. In each regular interradial area there are ten plates, the first one is hexagonal, rests between the upper sloping sides of the first primary radials, separates the second primary radials and is followed by two smaller plates in the second range, three in the third range, two in the fourth range and two in the fifth range, that separate the last tertiary radials and unite with the plates of the vault. The azygous area is large and contains twenty-two plates. The first one is in line with the first primary radials and about as large; it is followed by three plates in the second range, five plates in the third range, four plates in the fourth range, four plates in the fifth range, three in the sixth range, and two in the seventh range that separate the last tertiary radials and unite with the plates of the vault.

The vault is highly convex in the central part and over the ambulacral channels and depressed toward the margin in the interambulacral areas. There is a large spine bearing plate in the center of the vault and one over the junction of the ambulacral canals in each of the five radial series. The other plates of the vault are polygonal, not tumid or spinous, but radiately sculptured after the manner of those forming the calyx. The plates are generally small and the sculpturing is so delicate and the sutures so indistinct that the artist found it impracticable to represent these characters in the illustrations. The azygous opening is large, subcentral, elevated and surrounded, at the base, with numerous small plates.

The general form and number of plates in the secondary and tertiary series will at once distinguish this species from *M. expansus*, and it is so different from all other sixteen armed species, that no comparison with any of them is necessary. It is a marked and beautiful species.

Found in the Hamilton Group, in Clarke county, Indiana, and the one figured is now in the collection of S. A. Miller, while there are four specimens in the collection of J. F. Hammell, of Madison, Indiana, and many more than that in the collection of Wm. F. E. Gurley, varying from one-fourth the size of the specimen illustrated, to more than twice its dimensions.

MEGISTOCRINUS HEMISPHERICUS, n. sp.

Plate II, Fig. 18, basal view azygous side up; Fig. 19, azygous side view; Fig. 20, summit view.

Species medium size. Calyx subhemispherical, broadly flattened below, a little more than one-half wider than high, not constricted below the arms. Arm openings directed upward at an angle of forty-five degrees. Surface in our specimens apparently smooth, without any tumid plates, though as our specimens are silicified, the granules, if any, are destroyed. Column large and having a large canal. The sutures are nearly all obliterated, in our specimens, above the third primary radials rendering a technical description of the plates above the third primary radials impracticable.

The basal plates are substantially covered by the end of the column. The first primary radials are rather large, slightly unequal in size, directed from the column nearly horizontally, and those abutting on a single basal plate are hexagonal and those abutting upon two basals are heptagonal. The second primary radials are hexagonal, differ in size and are about as large as the first. The third primary radials are smaller than the first or second, three are pentagonal and two are hexagonal. They are axillary and bear the secondary radials. Two of the lateral rays have no tertiary radials and therefore have only two arms each. The ray on the left of the azygous area has four arms; the ray on the right of the azygous area has three arms and the ray opposite the azygous area has three arms. This arrangement gives to the species fourteen arms. In the regular interradial areas there is one hexagonal plate separating the second primary radials, and two plates in the second range separating the third primary radials, each of which is about the size of the primary radials; above these plates the sutures are not distinct. The azygous area is large and protuberant, at the third and fourth ranges of plates. The first azygous plate is in line with the first primary radials and nearly as large; it is followed by three plates in the second range and by five plates in the third range, all of which are subequal in size; above these plates the sutures are not distinct in our specimen, but there seems to be five plates in the fourth range.

The vault is only moderately convex over the ambulacral areas, and rather slarply depressed toward the margin in the interambulacral areas. There is a tumid plate in the center and an azygous opening adjoining it. The sutures are destroyed in our specimen. There are no spinous plates over the ambulacral canals. This species is distinguished by its general form and fourteen arms.

Found in the Hamilton Group, in Clarke county, Indiana, and now in the collection of Mr. J. F. Hammell.

ACTINOCRINUS ALBERSI, n. sp.

Plate II, Fig. 21, azygous side; Fig. 22, apposite view; Fig. 23, summit view.

Species medium or above medium size. Calyx obconoidal, from one-third to one-half wider than high; plates convex and the larger ones sculptured so as to be more or less pyramidal, angles slightly depressed. No radial ridges. Column medium size.

Basals very short and project almost their entire length below the end of the column. They are beveled at the sutures so as to give the base a subhexagonal outline. The cicatrix for the attachment of the column is nearly or quite flat. First radials wider than long, three hexagonal, and two heptagonal, widening from the base to the lateral angles and contracting above. Second radials from one-fourth to one-half smaller than the first, hexagonal, and wider than high. Third primary radials a little smaller than the second, pentagonal, axillary, and support on each upper sloping side a single secondary radial, which is axillary, and, in three of the rays, support on each upper sloping side a tertiary radial, which gives to each of these rays four arms. In each ray adjoining the azygous area, there is, on the distal side of each third primary radial, a secondary radial, that supports upon each upper sloping side a single tertiary radial; but the secondary radial on the proximal side of the third primary radial bears upon its distal side an axillary tertiary radial, that bears upon each upper sloping side a quarternary radial, and upon its proximal side two tertiary radials, which gives to each of these two rays five arms. There are, therefore, twenty-two ambulacral openings to the vault, in this species.

The regular interradial areas do not connect with the plates of the vault. In each of three of the areas there are five plates, one, followed by two in the second range and two in the third range; but in the other area there are six plates, one, followed by two in the second range, and two in the third range, and one small plate, in the fourth range. We do not suppose, however, that this slight difference, in the interradial areas, is of specific importance, and describe it only because our specimen is so constructed. The azygous area connects with the vault and contains eleven plates. The first one is in line with the first primary radials though much smaller; it is followed by two plates in the second range, one of which is larger than it is. There are four plates in the third range that gives to the area a width nearly as great as the length. There are three plates, in the fourth range, that are followed by a single plate in the fifth range, that connects with a singe plate belonging, at least in part, to the vault. An ovarian pore is at a lateral angle of the last mentioned plate, which shows that it should be classed with the vault plates rather than with those of the calyx. There is a single, small, intersecondary plate in the area between the two arms and the three arms in each ray adjoining the azygous area.

The vault is elevated above the ambulacral openings, convex, and bears a central proboscis. It is covered by numerous polygonal, convex or spinous plates. It is not concave in the regular interradial areas, but is concave toward the margin in the azygous area. There are fourteen ovarian apertures, two separating the two arms from the three arms belonging to each ray adjoining the azygous area and two between the ambulacral openings belonging to each of the five radial series.

The specimen upon which this species is founded was collected by R. A. Blair, at Sedalia, Missouri, and was presented by him to S. A. Miller, among other fossils from the Chouteau limestone of that locality, several years ago. It has the light lead color of the Chouteau fossils and that of light yellowish color of the fossils from the Burlington Group of that locality. Were it not the color of the fossil itself, we might suppose that it is from the Burlington Group, and that it had accidently fallen in with the Chouteau fossils. But the rock is evidently the same as that in *Actinocrinus* (?) *Chouteanensis*, collected by Mr. F. A. Sampson and in other crinoids described from the Chouteau limestone of Sedalia. It does not seem to have any near affinity with any other crinoid from rocks of the age of the Chouteau, nor is it near enough specifically, to any described form from the Burlington Group to require any comparison for the purpose of pointing out differences. We have no doubt that it is from the Chouteau Group. The specific name is in honor of Mr. A. Albers, of Cincinnati, Ohio, who did the drawing for this bulletin, and who is a good palæontologist as well as an excellent artist.

STROTOCRINUS BLAIRI, n. sp.

Plate II, Fig. 24, lateral view, some of the sutures obscure at the canopy.

Species medium size. Calyx below the canopy obpyramidal, truncated little, if any, beyond the size of the column, width about one-half more than the height. Plates convex, the larger ones bearing a central node, from which the plates are radiately sculptured. Radial ridges on the lower side of the canopy or projecting summit, but not distinguishable below the third primary radials.

Basals form a very low cup or rim more than four times as wide as high; sutures beveled; facet for the attachment of the column concave. First primary radials a little wider than high, three hexagonal, two heptagonal. Second primary radials about half as large as the first, wider than long, hexagonal. Third primary radials nearly as large as the second, wider than long, heptagonal and supporting on each upper sloping side a single secondary radial, which is axillary and supports on each upper sloping side the tertiary radials. As far as the sutures can be determined in our specimen, where there is a single tertiary radial in any series, it is axillary and bears quaternary plates, but where there are two or more tertiary plates in the series the last one is not axillary. The rays on each side of the azygous area have each six arm openings to the vault, and one of the lateral rays has the same number and the other two rays as far as preserved indicate the same number. It is, therefore, believed, that there are thirty arm openings to the vault.

The regular interradial areas are elongated and cut off from the vault by the tertiary and quaternary plates. There are eight plates in each area, one in the first range, two in the second, two in the third, two in the fourth and one in the fifth. The azygous area is also cut off from the vault by the quaternary plates. The first plate is in line with the first primary radials and nearly as large, it is followed by two plates in the second range, four in the third, four in the fourth and above these there are three or more small plates but the sutures are too indistinct in our specimen to definitely determine the number.

The vault is quite convex and bears a central proboscis. It is covered with numerous, highly convex, polygonal plates.

This species is so well marked that it is unnecessary to compare it with any hitherto described.

Found in the Burlington Group, at Sedalia, Missouri, by R. A. Blair, in whose honor we have proposed the specific name, and now in the collection of S. A. Miller.

ACTINOCRINUS FOVEATUS, n. sp.

Plate II, Fig. 25, azygous side; Fig. 26, view opposite the azygous area of another specimen, the calyx is a little flattened in both specimens.

Species medium size. Calyx obconoidal, more rapidly spreading in the upper part than below, especially in the region of the secondary and tertiary radials; about one-half wider than high; plates convex, sculptured, more or less stellate; radial ridges angular in the superior part, and angles of the plates depressed.

Basals short, slightly constricted above; sutures beveled; columner cavity broad and shallow. First radials rather wider than long, except the radial on the left of the azygous area, which is longer than wide, three hexagonal, two heptagonal. Second primary radials about half as long as the first, hexagonal, and wider than high, except in the ray on the left of the azygous area, where the second radial is heptagonal and longer than wide. In this ray there is no third primary radial and the second occupies the position of the second and third primary radials. This feature may be abnormal, but as the first plate is larger than it is in either of the other rays the peculiarity must have commenced with the commencement of the growth of the specimen and is not due to any injury that it could have received. The fact that *Shumardocrinus* never had but two primary radials in any of its rays leads one to believe, that, in this species, one of the rays, in its normal condition, may never have had more than two. While we have two specimens of this species this particular ray happens to be wholly preserved in only one of them. Third primary radials, in the four rays, a little larger than the second, three of them pentagonal, and the one on the right of the azygous area hexagonal, as shown in both of our specimens; all are axillary, and support on each upper sloping side a single secondary radial, which is axillary and supports upon each superior sloping side a single tertiary radial, except in the ray on the left of the azygous area, where there are two tertiary radials. This peculiarity in the ray having only two primary radials does not appear to be abnormal, and certainly is not the result of any mechanical injury. There are, therefore, twenty ambulacral openings to the vault.

In one of the regular interradial areas adjacent to the ray opposite the azygous area there are six plates, one of which connects with the plates of the vault, and in the other area there are seven plates, one of which connects with the plates of the vault. In the other two regular areas there are only five plates, neither of which reaches the plates of the vault, because the areas are cut off by the union of the tertiary radials. The azygous area contains nine plates. The first one is in line with the first primary radials and somewhat smaller; it is followed by two plates in the second range, five plates in the third range, and only one in the fourth range which is cut off from the vault by the union of the tertiary radials above it.

Vault very convex and having more capacity than the calyx. It is covered by large, polygonal, spiniform plates. The vault is injured at the summit in both of our specimens so the character of the proboscis cannot be determined. No ovarian pores discovered.

This species, in some respects, resembles a *Batocrinus*, but the hexagonal, second primary radials must place it in the genus *Actinocrinus*. The fact that the azygous area and the two interradial areas adjoining do not connect with the vault, while the other two interradial areas do, would seem to be of specific importance, without reference to the want of uniformity in the number of plates, in the different areas. The ray on the left of the azygous area, if normal, will distinguish this species from all others and as the ray on the right is the same in each specimen we think the one on the left is normal. The general form and surface ornamentation will distinguish this from all other species having twenty arm openings to the vault, though it resembles *A. fossatus* which has forty arm openings to the vault.

Found by R. A. Blair, in the Burlington Group, at Sedalia, Missouri, and now in the collection of S. A. Miller.

SAMPSONOCRINUS, n. gen.

[Ety. *The generic name is intended as a compliment to a distinguished naturalist, Mr. F. A. Sampson, of Sedalia, Mo.*]

Body more or less globose. Basals three, subequal, one pentagonal, two hexagonal. Primary radials either two or three in each radial series and differing in this respect in the different radial series in the same specimen. Secondary and tertiary radials present. Interradial plates connect with those of the vault, and, in three of the areas the first plate abuts upon the basals, by which arrangement eight plates unite with the basal disc. Vault elevated over the ambulacral canals, and depressed in the interradial spaces. Proboscis subcentral. Type *S. hemisphericus.*

We refer this peculiar genus to the family Actinocrinidæ.

SAMPSONOCRINUS HEMISPHERICUS, n. sp.

Plate III, Fig. 7, basal view; Fig. 8, summit view; Fig. 9, azygous side, the sutures between some of the plates being obscure; Fig. 10, lateral view.

General form of the calyx hemispherical, rather more than one half wider than high, broadly rounded below. Plates convex. Surface granular. Columnar facet very small. Arms directed horizontally.

One of the basal plates is pentagonal and two hexagonal, and they differ but little in size. When united they form a disc having three re-entering angles, in one of which an azygous plate is supported, and each of the others support, a radial series. The pentagonal plate is truncated by a radial and the hexagonal plates are truncated by a radial and by an interradial. By this arrangement the basal plates, when united, form a disc having eleven sides and abuts upon eight plates, a peculiarity we have never observed in any other fossil.

The first primary radials are longer than wide, very unequal in size, two pentagonal, two hexagonal, and one heptagonal. The radial series are so different that we will describe them separately. The first primary radial that truncates the pentagonal basal plate is the largest plate in the body, heptagonal, and has a width greater than its length. It is followed by a second primary radial, one-half smaller than the first, longer than wide and heptagonal. This is followed by a short, small, third primary radial that is heptagonal, axillary and supports upon each superior sloping side a small secondary radial, which gives to this ray two arm openings that enter the vault horizontally. In one of the series, supported in one of the re-entering angles of the basal disc, the first primary radial is very large and hexagonal. It is followed by a second primary radial, that is very large, wider than long, heptagonal, axillary, and supports on one of the superior sides a single. secondary radial, which is axillary and supports tertiary radials, and upon the other two secondary radials, the last of which is axillary and supports tertiary radials, which gives to this ray four arm openings to the vault, that are directed horizontally. In the other series supported in a re-entering angle of the basal disc, the first primary radial is much smaller than the one last described, longer than wide and pentagonal. It is followed by a second primary radial much larger than itself, wider than long, having eight sides, axillary and supporting, on the left lateral side a single secondary radial that is axillary and supports tertiary radials, and, on the superior side, a single secondary radial that is not axillary, and, on the right lateral side, a secondary radial that is axillary and supports tertiary radials, which arrangement gives to this ray five arms. It will be noticed here, that the two radial series supported in the re-entering angles of the basal disc have no third primary radials. In the radial series, on the right of the azygous area, the first primary radial is large, longer than wide, hexagonal, and followed by a second primary radial, which is much smaller, hexagonal, and followed by a third primary radial, which is still smaller, much wider than long, hexagonal, axillary, and bears upon each superior side a single secondary plate, which is short and axillary and bears tertiary radials, which gives to this ray four arm openings to the vault. In the radial series, on the left of the azygous area, the first primary radial is small, longer than wide, pentagonal, and followed by a second primary radial, nearly as large, longer than wide, hexagonal, and followed by a third primary radial, much wider than long, octagonal, axillary, and bearing on the superior sloping sides a single secondary radial, which is axillary and bears tertiary radials, which gives to this ray four arm openings to the vault. It will be observed that the three radial series that truncate the basal disc have, each, three primary radials, though the plates differ in relative form and size. There are, therefore, nineteen arm openings to the vault. The first arm plates are small, and the arms are directed horizontally. Beyond this, the arms are unknown.

The interradial areas differ, in form, and in the number of plates, and in position, as much as the radial series do, and, though they all connect with the vault and the plates grow less in size, until they unite with the plates of the vault, they will be separately described. In the area on the right of the azygous area, the first plate rests on the basal disc. It is large, longer than wide, hexagonal and is followed by two rather large plates in the second range, and five in the third range, which connect with the plates of the vault, but in this species there is no line separating the plates, in the interradial areas, from the vault, as they all graduate into each other. In the area on the left of the azygous area, the first plate rests on the basal disc. It is large, much longer than wide, heptagonal, and is followed by two plates, in the second range, that unite with three plates which belong to the vault. In the area on the right of the radial series that truncates the pentagonal plate belonging to the basal disc, the first interradial rests between the superior lateral sides of the first primary radials. It is moderately large, hexagonal, and is followed by two plates in the second range that unite with three plates belonging to the vault. In the area on the left of the radial series that truncates the pentagonal plate belonging to the basal disc, the first interradial rests between the superior lateral sides of the first primary radials. It is not as large as the corresponding plate last described, pentagonal and is followed by a single plate, in the second range, that unites with three plates belonging to the vault. This is the smallest of the interradial areas and has only two plates in it. In the azygous area as usual in the *Actinocrinidæ*, the first plate enters one of the re-entering angles of the basal disc, and is in line with the first primary radials. It is longer than wide, hexagonal and followed by two smaller plates, in the second range, three in the third, and four in the fourth, which unite with the plates of the vault in a zigzag line, without any definite mark of separation.

The vault is convex, having the radial areas highly and narrowly elevated with abruptly descending, wide interradial areas. It is covered with numerous, rather small, convex, polygonal plates. It had a small, subcentral proboscis, which is broken off in our specimen, at the summit of the vault

Found in the Chouteau limestone, at Sedalia, Missouri, by Mr. F. A. Sampson, and now in his collection.

AMPHORACRINUS SEDALIENSIS, n. sp.

Plate V, Fig. 34, summit view of a small specimen; Fig. 35, azygous side of a large specimen; Fig. 36, basal view of same; Fig. 37, summit view of same.

Species from medium to large size. Calyx semi-elliptical, or bowl-shaped, one-fourth wider than high, broadly rounded below. Interradial areas depressed between the arm bases where they unite with the plates of the vault. Plates convex, sculptured, more or less stellate. No radial ridges. Column round, medium size, and facet for attachment only slightly concave.

Basals short, and forming an hexagonal disc only about one-half wider than the diameter of the column. First radials a little wider than long, three hexagonal, two heptagonal. Second primary radials about two-thirds as large as the first, longer than wide, hexagonal. Third primary radials short, much smaller than the second, pentagonal, axillary and support on each upper sloping side a single secondary radial.

The secondary radials are directed nearly horizontally and stand out, their full length, from the interradial areas. There are ten arm openings to the vault.

There are three regular interradials in each area. The first one is as large as a second primary radial and reaches about as high, hexagonal, and supports two rather large plates that unite with the plates of the vault. There are nine plates in the azygous area. The first one is in line with the first primary radials and nearly as large. It is followed by two plates, equally as large, in the second range. There are four plates in the third range, though one of them touches one of the plates of the second range only at an angle, and on each side of the superior part there is a single plate. The last three plates unite with the plates of the vault.

The vault is highly elevated over the ambulacral canals and correspondingly depressed interradially. It is covered with numerous convex, polygonal plates and bears a large sub-central proboscis.

There is no described species very closely resembling this one, though we have no doubt that we have before us a true *Amphoracrinus*.

The large specimen illustrated was found by R. A. Blair, in the Chouteau limestone, at Sedalia, Missouri, and is now in the collection of S. A. Miller. The smaller specimen is from the same rocks and is in the collection of F. A. Sampson. The sculpturing is best preserved on the smaller specimen.

FAMILY MELOCRINIDÆ.

MELOCRINUS SAMPSONI, n. sp.

Plate II, Fig. 27, basal view; Fig. 28, azygous side; Fig. 29, opposite view.

Species above medium size. Calyx obconoidal, as far as the secondary radials, which are directed horizontally, so as to give the summit a pentagonal outline; truncated by large column; diameter nearly twice as great as the height. Plates highly convex and more or less radiately sculptured.

The four basals form a short rim, which is slightly lobed by the depression of the suture lines, and almost covered below by the end of the column. First radials the largest plates in the calyx, a little wider than high, three heptagonal, two hexagonal. Second primary radials about half as large as the first, wider than high, four hexagonal, one pentagonal. They differ somewhat in size. Third primary radials smaller than the second, the superior part directed nearly horizontally, three pentagonal, two hexagonal, axillary, and support on each upper sloping side a single secondary radial. The secondary radials are short and directed horizontally, and the articulating facets are quite concave, and each one is marked by a large ambulacral notch. There are only ten ambulacral openings to the vault.

There are five plates, in each regular interradial area. The first one is about as large as a second primary radial, it is followed by two smaller plates, in the second range, and these by two plates, in the third range, that separate the secondary radials and curve in upon the vault to unite with the plates of the vault. There are ten plates in the azygous area. The first one is in line with the first primary radials and of about the same size; it is followed by two plates in the second range, three in the third range, and four in the fourth range, that curve in upon the vault to unite with the summit plates.

The vault is unknown.

This species is so radically different from all others that have been described, that no comparison with any of them is necessary.

Found by Mr. F. A. Sampson, the well known and prominent naturalist, in the Chouteau limestone, at Sedalia, Missouri and now in his collection. The specific name is in honor of the collector.

FAMILY DOLATOCRINIDÆ.

DOLATOCRINUS NODOSUS, n. sp.

Plate III, Fig. 1, basal view; Fig. 2, azygous side view; Fig. 3, summit view.

Species above medium size. Calyx hemispherical, broadly truncated below. No radial ridges. Each plate bears a prominent conical central node, from the base of which there are numerous, more or less interrupted radiating lines, and toward the upper part, irregular, low, scattering nodes. Column round and having a large cinque foil columnar canal.

Basal plates almost covered by the column. First primary radials wider than long, the two on the azygous side being somewhat larger than the others. Second primary radials about one half wider than long, quadrangular. Third primary radials expand slightly to the superior lateral angles, longer than the second, pentagonal, axillary, and in the ray on the right of the azygous area bears a single, secondary radial upon each superior, sloping side, which is axillary, and bears upon each superior sloping side two tertiary radials, which gives to this ray four arms. In each of the other four rays, the third primary radial bears upon one upper sloping side three secondary radials, and upon the other, one secondary radial, which is axillary, and supports upon each upper sloping side, two tertiary radials. This arrangement gives to each of these rays three arms. There are, therefore, sixteen arms and sixteen ambulacral openings to the vault in this species.

The azygous area is like the others, except a little larger. The first interradials are the largest plates in the calyx, have nine sides, and are broadly truncated above for the second interradials. The second interradials are about half as large as the first, and are followed by a single plate, which is about half as large as the second, and unites with two large, elongated plates belonging to the vault.

The vault is very slightly elevated over the radial areas, and about equally as much depressed in the interradial areas. It is substantially covered by three circles of plates, the surface of which is covered by granules. and a few of the plates over the radial areas bear a small central node, as shown in the illustration. The subcentral azygous opening is slightly elevated and surrounded by four plates, two of which form part of the first circle of plates and, if counted with the first circle, there are seven plates in the first circle, and without them there are only five; but the circle is not complete without counting one of them. In the second circle there are seven plates. In the third circle there are fifteen plates, two in each depressed interradial area that unite with the plates of the calyx and one over each radial area. These are all the plates covering the vault except those over the radial areas at the base of the arms. There are no ovarian openings, at least, in a beautifully preserved specimen none can be discovered.

This species bears more resemblance to *Dolatocrinus bellulus* than to any other, but is readily distinguished by having only sixteen instead of seventeen arms, and by having no ovarian openings. There is also some difference in the convexity and structure of the vault and in the surface ornamentation.

Found in the Hamilton Group, near Charlestown, Indiana, and now in the collection of Mr. J. F. Hammell, of Madison, Indiana.

DOLATOCRINUS SACCULUS, n. sp.

Plate III, Fig. 11, basal view; Fig. 12, side view.

Species medium or below medium size. Calyx subhemispherical, broadly truncated at the base and subcylindrical above. Radial ridges consisting of small, rounded elevations, which are interrupted by central nodes on the plates. Surface ornamented with radiating ridges from the central part of the plates that do not unite with the radial ridges or coalesce with the central nodes. The radiating ridges are toward the margin of the plates, and the second interradials have no central nodes. Column round, medium size, and having a large cinque foil canal.

Basal plates hidden by the column and a rounded flanging rim that surrounds it, on the basals and at the commencement of the first primary radials. First primary radials a little wider than long, and subequal in size. Second primary radials rather less than twice as wide as long, quadrangular, sides nearly parallel. Third primary radials very little larger than the second, from one-half wider to twice as wide as long, pentagonal, axillary, and bear upon each superior sloping side a single secondary radial. The secondary radials bear upon each superior sloping side a single tertiary radial, which gives to this species twenty ambulacral openings to the vault.

The first interradials are rather large and have nine sides. There is only a single plate in the second range and it extends to the top of the calyx and connects with the plates of vault. The azygous area is not materially different from the other areas.

The vault is moderately convex and bears rather sharp radial ridges. The sutures cannot be distinguished in our specimen. There are twenty ovarian apertures, one on each side of each pair of arms. They are elongated and are close to the ambulacral canals, and not through the vault itself as in some species.

This species, when compared with *D. corporosus*, will be found to have only a single tertiary radial, while in that species there are four, and only two interradials, while in that species there are from three to six plates, and the azygous area is altogether different. There are also some minor differences in surface ornamentation and otherwise. There is no necessity for comparing it with any other known species.

Found by Geo. K. Greene, in the Hamilton Group, near Charlestown, Indiana, and now in the collection of Wm. F. E. Gurley.

DOLATOCRINUS SALEBROSUS, n. sp.

Plate III, Fig. 13, basal view; Fig. 14, side view; Fig. 15, summit view.

Species medium or below medium size. Calyx subhemispherical, concave below and slightly constricted below the arms. Radial ridges consisting of small, rounded elevations which are interrupted by central nodes on the plates. Surface ornamented with radiating ridges from the nodes and central part of the plates. The second interradials have a transverse central ridge with longitudinal ridges below it. Column round medium size, and nearly filling the funnel-shaped cavity formed by the basal plates.

Basal plates form a cup that is inserted into the cavity of the calyx and is nearly filled by the end of the column. The mouth of the cup is about one-fourth wider than the diameter of the column. First primary radials about as long as wide and curve, at the lower end, into the basal concavity to unite with the basal plates, and upward at the superior end, so that the calyx will rest upon the middle part of these plates. Second primary radials from one-fourth to one-half wider than high, quadrangular, and slightly expanding upward. Third primary radials a little larger than the second, about one-half wider than high, three hexagonal, two pentagonal, axillary, and, in two of the rays, bear upon each upper sloping side a single secondary radial which is axillary and bears upon each superior side two tertiary radials, which gives to each of these rays four arms. In each of two other rays, the third primary radial bears upon one superior sloping side two secondary radials and, upon the other, a single secondary radial, which is axillary and supports, on each superior sloping side, two tertiary radials, which arrangement gives to each of these two rays three arms. The other ray, in its normal condition, may be like the last two, and if so, the species will have seventeen arms, but in the specimen illustrated, it is different and is peculiarly constructed, as follows. Upon one side of the third primary radial there is a single secondary radial, which is axillary and bears upon each superior side a single tertiary radial, and, upon the other side of the third primary radial, an interradial is supported, without the intervention of a secondary radial, and, therefore, there are only two arms to this ray, which gives us only sixteen arms in the specimen illustrated, and, until it can be shown, that this structure is abnormal, the species must be regarded as possessing only sixteen arms.

The first interradials are of unequal size, one of them is heptagonal and each of the others has nine sides. The heptagonal plate is followed by two plates, in the second range, one of which rests, in part, on one of the superior sides of a third primary radial and takes the position of a secondary radial in the two-armed ray. These two plates in the second range connect with two plates belonging to the vault. In the other four areas, one plate, in the second range, is followed by one in the third range that unites with two plates belonging to the vault.

The vault is moderately convex over the ambulacral canals and correspondingly depressed in the interradial areas. It is covered by a few rather large polygonal plates that bear pustules, and each one over the junction of the ambulacral canals bears a central node. The azygous orifice is central. No ovarian pores can be distinguished.

We regard the interradial area having the first plate heptagonal as the azygous area, and, if the two-armed ray is abnormal and the species has seventeen arms, then it will resemble *D. aureatus*, from which it will be readily distinguished, by the interradial areas; for in that species, there are three plates, in the third range, that unite with the plates of the vault, in the regular areas, and four or five in the azygous area. Besides, the ornamentation is different in the two species, and the proboscis in that species is large and subcentral and the arrangement of the plates on the vault is quite different in the two species. But if the two-armed ray is normal then this is a sixteen armed species so different from all other sixteen armed species that have been described, that no comparison with any of them is necessary.

Found by Geo. K. Greene, in the Hamilton Group, near Charlestown, Indiana, and now in the collection of Wm. F. E. Gurley.

FAMILY POTERIOCRINIDÆ.

POTERIOCRINUS BLAIRI, n. sp.

Plate IV, Fig. 1, azygous view, the arms on the right a little compressed; Fig. 2, view showing the ray opposite the azygous area on the left, one of the arms is spread out of place.

Species medium size, robust, and having wide arms that fit closely together as in *Zeacrinus*. Calyx obconoidal, nearly twice as wide as high, truncated below for a rather large column; sutures distinct; surface smooth.

Basals very short, three or four times as wide as high. Subradials wider than high, three haxagonal, and two heptagonal; those adjoining the azygous area are heptagonal.

First radials of unequal size, but about twice as wide as high; truncated the entire width above and separated from the first brachials or arm plates by a slightly gaping suture. The second radials or brachials, as they are usually called, are of unequal size and not uniform in shape. In four of the rays these plates are wider than high, pentagonal and support upon each upper sloping side the secondary radials or free arms. The secondary radials are short, wide, quadrangular and abut against each other. In one of the series, the fifth plate is pentagonal, axillary and supports upon each upper sloping side the tertiary radials; in the other series, preserved in our specimen, the sixth plate is axillary, pentagonal and supports on each upper sloping side the tertiary radials. No further bifurcation is shown, though ten tertiary radials are preserved. The tertiary radials are short, wide, quadrangular, and abut against each other, in the same manner that the secondary radials do. This arrangement gives to each of these four rays four arms. In the ray opposite the azygous area, the second primary radial is the largest plate in the body and nearly square. It is followed by a short, quadrangular plate, and then follows a short pentagonal plate, that is axillary and supports upon each upper sloping side a long series of short, wide, quadrangular, secondary radials, which gives to this ray two arms. There are, therefore, eighteen compact arms in this species.

The azygous area is of moderate size and the plates are arranged as is usual in this genus. The first one is pentagonal and rests between the sloping sides of two subradials and below the under sloping side of the first radial, on the right. The second plate is long, hexagonal, truncates a subradial and reaches as high as the top of the second radial on the left. The fourth plate is much smaller than the third, truncates the second and extends a little beyond the third. The fifth plate truncates the third and is not fully exposed in our specimen.

This species is readily distinguished by its general form, and, so far as known, has no nearly related species, in the group of rocks, in which it occurs.

Found by R. A. Blair, in the Burlington Group, at Sedalia, Missouri, and now in the collection of S. A. Miller. The specific name is in honor of the collector.

POTERIOCRINUS ALTONENSIS n. sp.

Plate IV, Fig. 3, azygous area on the right, calyx arms and part of the column, compressed; Fig. 4, opposite view of same specimen.

Species quite small, constricted above the calyx in the middle of the second radials or brachials. Calyx short, hemispherical or bowl-shaped, nearly twice as wide as high; plates convex; sutures distinct; surface granular. Column quite small and round, the alternate plates slightly projecting.

Basals depressed and extending a little beyond the column, so as to be seen from a basal view. Subradials rather wider than long and forming, with the basals, a low cup. First radials wider than long, pentagonal, truncated the entire width above and separated from the second radials or brachials by a gaping suture. A single, elongated, brachial or second radial, rounded and contracted in the middle, and axilliary, supports upon its superior sloping sides, in each radial series, the free arms. The arms are long, slender, round and composed of rather long plates which are slightly constricted in the middle part. The first plates are longer than the succeeding ones. The arms do not bifurcate and there are, therefore, only ten arms in this species. Pinnules distant.

Azygous plates are as usual in this genus; the first one is pentagonal, about half as large as a subradial, rests upon the upper sloping sides of two subradials and between the first radial, on the right, and the second azygous plate, on the left, and is truncated, at the top, for the third azygous plate; the second plate is pentagonal, about as large as the first, rests upon the truncated upper end of a subradial, and between a first radial, on the left, and the first and third azygous plates, on the right, and is truncated at the upper end, for the fourth plate. The fourth plate extends beyond the third.

This species is distinguished by its small size, hemispherical calyx, long, constricted brachials and ten arms. When compared with *P. rowleyi* it will be noticed, that species has two brachials, in some of the rays, and all the arms bifurcate toward the top. It will not be mistaken, for any other species, by any one capable of making a comparison.

Found by the late Hon Wm. McAdams, who was a prominent naturalist, in the St. Louis Group, at Alton, Illinois, and now inthe collection of S. A. Miller.

POTERIOCRINUS BROADHEADI, n. sp.

Plate IV, Fig. 7, azygous side view; Fig. 8, lateral view.

We have examined six specimens belonging to this species, one a third larger than the specimen illustrated, three others as much smaller, and each one is longer and larger upon the azygous side than upon the opposite side, showing the unsymmetrical form of the calyx is normal. Calyx irregularly obconoidal above the broad truncated base, by reason of the longitudinal convexity of the plates and the depressed sutures, or it might be called somewhat obpyramidal. The azygous side is longer than the other, the two rays opposite the azygous area are the shorter and of equal length, and, from these, there is a gradual lengthening to the top of the third azygous plate. All the plates are longitudinally convex and the sutures are depressed, especially at the angles, and a pore penetrates the calyx at every angle, and, on the longer sides, a pore penetrates the calyx between the angles. The greatest length of the calyx does not equal the diameter. Plates thick. Column unknown.

Basals small, wider than long, and project below the end of the column. Superior angles rather acute. Subradials the largest plates in the calyx and about as long as wide, though somewhat unequal in size, three hexagonal, two heptagonal. First radials about twice as wide as long, though of unequal length, and slightly concave the entire width above for the reception of the second radials, none of which are preserved in our specimens.

The first azygous plate is about as large as a first radial, nearly equal sided, pentagonal, rests between the superior sloping sides of two subradials, separates the first radial, on the right, from the second azygous plate, on the left, and is truncated above by the third azygous plate. The second azygous plate is nearly as large as the first, truncates a subradial, separates the first radial, on the left, from the first and third azygous plates, and thins toward the upper edge, indicating that it united with small plates belonging to a proboscis. The third azygous plate rests upon the first and in its lower part separates part of the first radial plate, on the right, from the second azygous plate and thins toward the upper edge, indicating that it united with small plates belonging to the proboscis.

This is a peculiar species and on account of its azygous area and the pores that penetrate the vault, may yet be made the type of a new genus. At least it will not be confounded with any species that has been heretofore described in this genus.

Found by R. A. Blair, in the Chouteau limestone, near Sedalia, Missouri, and now in the collection of S. A. Miller. The specific name is in honor of Prof. G. C. Broadhead.

POTERIOCRINUS SAMPSONI, n. sp.

Plate IV, Fig. 9, azygous side view; Fig. 10, opposite view of same, some of the matrix is attached to the top of the first radials.

Species medium or below medium size, as indicated by two specimens, one of which is smaller than the one illustrated. Calyx like the frustum of a cone, being broadly truncated below, slowly expanding above and having a diameter about one-fourth greater than the height. Surface smooth, possibly, in better preserved specimens, granular. Plates thick and sutures close. Column large, at the superior end, as it entirely covers the truncated end of the calyx.

Basals moderate size, about a third or a half wider than high. Superior angles distinct though not acute. Subradials the largest plates in the calyx, wider than long, though unequal in size, three hexagonal, two heptagonal. First radials about twice as wide as long, though slightly unequal in size, and truncated the entire width above, for the reception of the second radials, none of which are preserved, in our specimens. The first azygous plate is smaller than a first radial, nearly equal sided, pentagonal, rests between the superior sloping sides of two subradials and separates the first radial, on the right, from the second azygous plate. The second azygous plate is much smaller than the first, truncates a subradial and separates the first one from the first radial, on the left. The third azygous plate is smaller than the second, as shown by the specimen, which is not illustrated, and beyond it, the plates are not preserved.

While this species is not distinguished by any very remarkable peculiarities, it is so different from any that have been described from rocks of the same geological age, that no comparison is necessary.

Found by R. A. Blair, in the Chouteau limestone, at Sedalia, Missouri, and now in the collection of S. A. Miller. The specific name is in honor of F. A. Sampson, a distinguished naturalist of Sedalia.

ZEACRINUS BLAIRI, n. sp.

***Plate IV**, Fig. 5, azygous side; Fig. 6, opposite side of same specimen, showing part of the proboscis.*

Species below medium size. Calyx low, basin-shaped, two and a half times as wide as high, depressed at the base, plates convex, sutures distinct, surface granular. Column small and round.

Basals form a disc one-half larger than the diameter of the column, and, in plain view, as seen from below. Subradials wider than high, and forming, with the basals, a low cup. First radials wider than long, pentagonal, truncated the entire width above, and separated from the brachials by a gaping suture. A single brachial, about as long as wide, rounded and contracted, in the middle, and axillary, supports upon its upper sloping sides, in each radial series, the free arms. The proximal arm, on the left of the azygous area, bifurcates on the sixth plate, and the proximal side again on the ninth plate, and the distal side bifurcates on the fourth plate, and the distal branch on the eighth plate, which gives to this ray six arms. The ray opposite the azygous area bifurcates, on one branch, on the fourth plate, and, on the other, on the seventh plate, which gives to it four arms. One of the lateral rays bifurcates, on each branch, on the sixth plate, which gives to it four arms. The other two rays are broken off below the first bifurcation, in our specimens, but we presume the lateral rays are alike, and the ray on the right of the azygous area the same as the one on the left, and if so, the species has twenty-four arms. The arms are short, round and composed of short plates. Pinnules small.

The azygous area is wide, ovate and exposes ten plates arranged alternately, as usual, in this genus. The first one is about half as large as a subradial, rests upon one sloping side of a subradial and abuts another, separates the first radial, on the right, from the second azygous plate and is truncated by the third plate. The second one is about the size of the first, truncates a subradial, separates the first radial, on the left, and the lower part of the brachial, from the first and third plates and is truncated above by the fourth and fifth plates. The fourth, fifth and sixth plates are in one range crossing the exposed area. The top of the proboscis is broken off in the specimen illustrated, below the top of the arms, where it is round and covered by smooth, polygonal plates.

This species is at once distinguished, by its general form and number of arms, from all others. In *Zeacrinus pocillum*, from the same rocks, there are two brachials in each of four rays, and, in the other ray, the first brachial is truncated on top and followed by five single plates, before it bifurcates; and *Zeacrinus commaticus*, from the same rocks, with its forty-six arms, is equally as far removed from this species. We know of no species with which it is necessary to compare it.

Found in the Keokuk Group, at Boonville, Missouri, and now in the collection of S. A. Miller. The specific name is in honor of R. A. Blair, the distinguished naturalist and collector of Sedalia, Missouri.

FAMILY CYATHOCRINIDÆ.

CYATHOCRINUS BLAIRI n. sp.

Plate IV, Fig. 11, basal view of a large specimen, azygous side up; Fig. 12, azygous side of same showing the large subradial; Fig. 13, basal view of a small specimen; Fig. 14, azygous side of the same; Fig. 15, opposite side of same.

We have three specimens of this species, though one of them is so badly crushed that it is of no service in the description. The species is rather below medium size. The calyx of the larger specimen is bowl-shaped, a little less than twice as wide as high and broadly rounded below, while the smaller specimen is more elongated and pointed below. It is possible, that the larger specimen is compressed on the under side so as to throw it a little out of its normal shape. The sutures are beveled; surface granular; column small and round.

Basals small and form a low cup, with a concave depression for the attachment of the small column, and are separated from the subradials by a beveled suture. Subradials large and gently curve from the basal cup outward and upward. The one on the azygous side is remarkably large and extends nearly as high as the first radials. First radials wider than high, sides parallel, each arcuate the entire width above for the attachment of the second plate, and having the facet directed upward or slightly inclined inward. The first azygous plate is short and extends but slightly below the level of the first radials.

This species will be distinguished by its general form, remarkably large subradial which is truncated by a short azygous plate, and by the wide arcuate facets directed upward and inward, for the attachment of the second radials. Possibly its arms, when known, will be used to distinguish it from the genus *Cyathocrinus*.

Found by R. A. Blair, in the Choutean limestone at Sedalia, Missouri, and now in the collection of S. A. Miller. The specific name is in honor of the laborious and intelligent collector.

CYATHOCRINUS CHOUTEAUENSIS, n. sp.

Plate IV, Fig. 16, showing calyx and part of the arms, the azygous plate is on the right and the second and third radials in the adjoining ray are out of place, the calyx is also compressed so as to appear wider than it is.

Species medium size. Calyx obconoidal, about as high as wide, sutures close, surface granular.

Basals form a low conical cup, truncated for a small column. Superior angles obtuse. Subradials rather longer than wide, except the one truncated by the azygous plate which is wider than long, four hexagonal and one heptagonal. The heptagonal plate is the larger one. First radials about as long as wide, slightly curved over towards the vault on each side of the arm facets, and longitudinally convex and protuberant at the arm facets. Arm facets circular, occupying about half the width of the plates, and notched for the ambulacral canal. Azygous plate broadly truncates a subradial and extends above the top of the first radials.

There are only five arms. The arms are small, long and composed of long, round joints or plates. The first plate is not quite as long as wide but above this the plates are from two to four times as long as wide.

There is no described species, from rocks of the same age, with which this one can be confounded.

Found by the distinguished collector and naturalist F. A. Sampson, in the Choutean limestone at Sedalia, Missouri, and now in the collection of S. A. Miller, to whom he kindly presented it.

CYATHOCRINUS MACADAMSI, n. sp.

Plate IV, Fig. 31, azygous side on the right; Fig. 32, lateral view.

Species medium size, constricted above the calyx. Calyx short, hemispherical, twice as wide as high; plates convex; sutures distinct; surface finely granular. Column small.

Basals form a flat pentagonal disc about twice as wide as the diameter of the column. Subradials slightly wider than high and forming with the basals a low cup. First radials about one-half wider than long, pentagonal, truncated the entire width above, and separated from the second radials or brachials by a wide gaping suture. There are two brachials in each ray, the first one is quadrangular and about twice as wide as long, the second is somewhat smaller than the first, pentagonal, axillary and supports upon each upper sloping side a single arm. The body is broadly constricted in the region of the brachials. There are only ten arms and when closed they are compact, as the sides are straight and flattened. The arms are composed of wedge-shaped plates, the first ones being longer than the succeeding ones. In the three specimens examined there is some difference in the length of the arm plates and the longer ones appear to be slightly constricted, but the difference will not distinguish either specifically from the one illustrated. The first azygous plate truncates a subradial and extends a little above the top of the first radials.

The form of the calyx and the azygous plate agree with *Cyathocrinus*, but the brachials and arms remind one of *Poteriocrinus* and *Zeacrinus*. There is no described species for which this one can be mistaken.

Found by the late Hon. Wm. McAdams, in the St. Louis Group, at Alton, Illinois, and now in the collection of S. A. Miller. The specific name is in honor of the collector, who was well known as a naturalist of ability and close observation for many years.

CYATHOCRINUS BRITTSI, n. sp.

Plate IV, Fig. 35, basal view; Fig. 36, azygous side view of the calyx.

Species medium size. Calyx rather more than twice as wide as high, and somewhat obpyramidal in shape, in the superior part, though round over the subradial region. Sutures distinct, surface granular. Column large and round.

Basals form a pentagonal disc, one-third wider than the diameter of the column, which has a concave depression, though shallow, for the attachment of the column. Subradials slightly wider than high, the one on the azygous side being much larger than either of the others, though extending but little higher. First radials a little wider than high, longitudinally convex, most convex in the superior part, which gives the calyx, when seen from above, a subpentagonal outline The upper part of these plates, too, is very thick, and the facets for the articulation of the second plates are correspondingly deep, and scarred very slightly, for the ambulacral canal. The facets are about three-fourths of the width of the plates, and have a slight transverse depression that indicates a gaping suture. The first azygous plate broadly truncates a subradial at about the middle of the first radials.

This species will be distinguished, by its general form, from all others, so that no comparison with any of them is necessary for its identification.

Found by R. A. Blair, in the Burlington Group, at Sedalia, Missouri, and now in the collection of S. A. Miller. The specific name is in honor of Dr. J. H. Britts, one of the leading naturalists of Missouri.

FAMILY PLATYCRINIDÆ.

PLATYCRINUS TUGURIUM, n. sp.

Plate IV, Fig. 17, basal view; Fig. 18, azygous side view; Fig. 19, summit view.

This species is above medium size, and belongs rather to the discoid than to the bowl-shaped forms, and receives its specific name from a fanciful resemblance to a hut. Calyx shallow, pentagonal, two and a half times as wide as high. Plates thick, sculptured. Sutures beveled. The surface is ornamented with angular ridges and furrows as follows: An angular ridge extends from each angle of the basal disc to the columnar depression, and two or three ridges parallel with each side of the disc, are arranged between them; and, on each first radial, an angular ridge extends from each lower lateral angle, from one-half to two-thirds the length of the plate, to a constriction, or subcircular furrow, and these ridges are connected by three ridges parallel with the lower side, and there are three ridges between the subcircular furrow and each perpendicular suture.

Basals form a pentagonal disc, not higher than the thickness of the plates, with a concave depression in the central part, where the column attached; and sculptured as above described, though the sculpturing becomes less defined as it approaches the concave depression. First radials project, in the lower part, at an angle of about forty degrees; but, the superior part, beyond the constriction, is directed horizontally, and the facet, for the second plate is transverse, or nearly perpendicular, with a notch for the ambulacral canal. Surface ornamentation as above described. The angles for the reception of the interradials are more acute than is usual in this genus. There is only a single regular interradial, in each area, and it forms part of the vault.

Vault elevated and convex toward the central part, so as to have a capacity equal to or greater than the calyx. A single large spinous plate occupies the central part; it is surrounded with eight plates, six of which bear spines and the other two abut upon the azygous orifice. Each plate over the junction of the ambulacral canals bears a spine, the other plates are convex but not nodose. The azygous area is comparatively large, the first plate is as large as a regular interradial and stands nearly upright, and above on either side of it there are two small plates, and between and above these nine plates surround a large azygous orifice.

This species is readily distinguished by its general form and surface ornamentation from all heretofore described.

Found in the Burlington Group, at Sedalia, Missouri, by R. A. Blair, and now in the collection of S. A. Miller.

PLATYCRINUS FORMOSUS, n. sp.

Plate IV, Fig. 20, basal view; Fig. 21, azygous side view preserving the first azygous plate.

This species is about medium size and belongs to the discoid forms. Calyx shallow, pentagonal, four times as wide as high. Plates thick, sculptured. Sutures canaliculate. The surface is ornamented with a rounded ridge upon each side of the canaliculated sutures which bears more or less conspicuous rounded nodes. Column round.

Basals form a concave pentagonal disc, bordered by an angular nodose rim, that adjoins the canaliculated suture. The concavity is equal to the thickness of the plates and commences at the angular ridge adjoining the suture. The plates are serrated for the attachment of the column. The first radials project, at first, horizontally, and then curve upward, having a constriction in the middle part, beyound which they are directed horizontally, and the facet, for the second plate, is transverse or nearly perpendicular. Each articulating facet forms almost a circle, having a diameter more than one third the diameter of the plate, and being only slightly notched for the ambulacral canal.

The angles for the reception of the regular interradials are very obtuse, and the angle for the reception of the first azygous plate is moderately acute. The first azygous plate is pentagonal, stands upright and indicates a large area on account of its width, but it is shorter than the same plate in *P. tugurium*, and the probability is that the vault is less convex.

The calyx of this species has some resemblance in form to *P. truncatus*, but in that species, the base is flat and the surface is not ornamented, while in this species, the basal disc is quite concave and the column is inserted into the concavity and the surface is ornamented with ridges and nodes. Other differences in form, occur in the parts preserved. It cannot be mistaken for any other described species by any one capable of distinguishing specific characters.

Found by R. A. Blair, in the Burlington Group, at Sedalia, Missouri, and now in the collection of S. A. Miller.

PLATYCRINUS MISSOURIENSIS, n. sp.

Plate IV., Fig. 22, longer side view, showing the place for the attachment of the column; Fig. 23, shorter side view.

Species medium size, and the specimen upon which it is founded has longer first radials upon one side than upon the other, which forms an unsymmetrical calyx that may represent either the normal or an abnormal growth. It is also slightly compressed. Calyx somewhat bowl-shaped, broadly truncated below, outer face of the first radials flattened and sutures beveled, so that a transverse section will have a subpentagonal outline. Plates thick. Surface granular. Column round at the point of attachment, rather large and surrounded by a small projecting rim on the basals. Columnar canal large.

Basals form a pentagonal disc with a very shallow cup and have a projecting angular rim around the end of the column. The beveled and straight sutures between the basals and first radials give the basals a marked pentagonal outline. The first radials are a little larger upon one side of our specimen than upon the other, the longer ones expand most, so that each is only slightly wider than high. Each plate is flattened below the articulating facet for the second radial. Articulating facets very large, occupying from one-half to two-thirds the width of each plate and having a serrated outer edge, within which there is a straight tranverse ligamental furrow. Wide notch for the ambulacral canal.

This species is distinguished by its bowl shape and pentagonal outline, and remarkable articulating facets for the second radials.

Collected by R. S. Blair in the Chouteau limestone near Sedalia, Missouri, and presented by him to S. A. Miller.

PLATYCRINUS PETTISENSIS, n. sp.

Plate IV, Fig. 24, basal view; Fig. 25, side view of same specimen.

Species medium sized. Calyx bowl-shaped, truncated for the attachment of the column and projecting at the arm bases, so as to give it a pentagonal outline above. Surface smooth in the four specimens examined, and sutures slightly beveled. Column medium size.

Basals form a cup about twice as wide as high, pentagonal at the top, and truncated for the column. First radials wider than high, gradually expanding, convex longitudinally and projecting at the articulating scales. Articulating facets rather large, directed upward, at an angle of about sixty degrees, form more than a semicircle, occupy about half the width of a plate and are notched in the central part for the ambulacral canal.

This species is founded upon four specimens the larger one of which is illustrated. It resembles *P. annosus* more than any other described species, but will be distinguished from it, by the higher cup formed by the basal plates, larger truncation for the column, and more prominent and larger articulating facets for the second radial. We have examined fifteen specimens of *P. annosus*, and the above differences are constant, and the species need not be confounded even on a superficial examination.

Collected by R. A. Blair, in the Chouteau limestone, in Pettis county, Missouri, near Sedalia, and by him presented to S. A. Miller.

PLATYCRINUS CLINATUS, n. sp.

Plate IV, Fig. 26, shorter side of a large specimen; Fig. 27, longer side of same; Fig. 28, longer side of another specimen, showing an interradial on the azygous side; Fig. 29, shorter side of same; Fig. 30, longer side of a smaller specimen.

We have examined ten specimens belonging to this species, ranging in size between the largest and smallest specimens illustrated, and we believe the specimen illustrated by figure 4, plate I, Bulletin No. 4, Geo. Sur. Mo., belongs to this species, though it is not at hand for re-examination. All of the specimens are larger on one side than on the other, and the first radials are longer on one side than on the other, proving that this is the normal condition of the species. The larger side is the azygous side and opposite to the small basal. The basal plates are generally anchylosed, but in the specimens illustrated we have been able to see the sutures.

Species below medium size. Calyx with a large truncated base, above which it is abruptly constricted and then gradually expands to the top of the basals, and, from there, expands more rapidly to the facets for the second radials, which gives it a pentagonal outline on top. Sutures between the radials and between the basals and radials beveled. Surface granular. Plates thick. Column round and large.

Basals form a short subcylindrical cup, with an expanded base. First radials of unequal size, differing as much in width as in length, and subquadrate in outline; they are longitudinally convex in the central part, projecting most at the articulating facets for the second radials, and depressed at the longitudinal sutures. Articulating facets large, occupying about two-thirds the width of each plate, and sloping downward so as to be directed at an angle of sixty degrees, from a perpendicular line. The azygous interradial is large and stands nearly upright. The angles for the reception of the regular interradials are very obtuse.

This species will be readily distinguished, by its general form and thick plates, from all others. It bears most resemblance to *Platycrinus allophylus.*

Found by R. A. Blair, in the Chouteau limestone, at Sedalia, Missouri, and now in the collection of S. A. Miller.

PLATYCRINUS SULCIFERUS, n. sp.

Plate IV, Fig. 33, basal view; Fig. 34, side view.

Species above medium size and belongs to the discoid forms. Calyx shallow, pentagonal, two and a half times as wide as high. Plates thick, furrowed. Sutures broadly beveled.

Basal disc large, pentagonal, concave in the central part and having a furrow just within the pentagonal border. First radials wider than high, project at an angle of about forty-five degrees, sharply constricted below the facets for the second radials. The facets are semi-elliptical, directed horizontally, and broadly notched for the ambulacral canal. There is a furrow just within the beveled edge adjoining the basal disc, and one on each side of each plate adjoining the beveled suture. The angles for the reception of the regular interradials are obtuse The valt and arms are unknown.

This species is distinguished from other discoid species having beveled sutures, by the furrow within the border of each **plate,** without other ornamentation by the sharp angular constriction below the articulating facet, and by the semi-elliptical facet. These surface characters readily distinguish it from other species.

Found by R. A. Blair, in the Burlington Group, at Sedalia, Missouri, and now in the collection of S. A. Miller.

PLATYCRINUS CASULA, n. sp.

Plate IV, Fig. 37, basal view; Fig. 38, azygous side on the right; Fig. 39, view opposite the azygous side; Fig. 40, summit view.

Species medium size and belongs to the bowl-shaped forms. Calyx bowl-shaped, pentagonal, rather more than one and a half times as wide as high. Plates thick. Sutures broadly beveled. Surface without ornamentation. Column round at the calyx.

Basal disc pentagonal, nearly three times as wide as the diameter of the column and having a height about equal to the thickness of a plate. It is concave below for the column attachment, and bordered by an angular pentagon from which it is beveled to the suture above. First radials a little wider than high, slowly expand to form the cup and become convex toward the facets, for the second radials. The facets are semi-elliptical, directed at an angle of forty-five degrees, and occupy about half the width of the plates. The second radials are very short and axillary. The ambulacral notch is small in both the first and second radials. The angles for the reception of the interradials, which are in fact plates of the vault, are quite obtuse.

The vault is only slightly convex and is covered with a few rather large convex plates. Five large plates occupy the central part and these are surrounded by a single row of plates consisting of the interradials and those covering the ambulacral canals and those forming the proboscis on the azygous side. The proboscis is large and consists of numerous small plates, and the first azygous interradial, which is large, stands upright and forms part of it.

The species is distinguished by its pentagonal, bowl-shape, absence of ornamentation and peculiar vault and proboscis.

Found by R. A. Blair in the Burlington Group, at Sedalia, Missouri, and now in the collection of S. A. Miller.

PLATYCRINUS SEMIFUSUS, n. sp.

Plate IV, Fig. 41, side view; Fig. 42, basal view.

This species is founded upon two casts, but the specimens are in a fine state of preservation, and the ornamentation, we presume, indicates the ornamentation of the test. The species is above medium size. The calyx is pointed below, subpentagonal from the basals upward and constricted below and at the second radials, so as to destroy the subpentagonal outline. The heigth is a little more than the diameter and if the test were preserved the heigth would still be more than the diameter. The shape is half fusiform. The surface is ornamented with rounded ridges that radiate downward from the second radials to the base of the first radials and then contract to the pointed base below, and these ridges bear very fine longitudinal lines; or we might say the specimens are ornamented with longitudinal, low, fusiform ridges, that are longitudinally marked with very fine lines.

Basals form a cup, pentagonal above and pointed below, and having a diameter equal to about two and a half times the height. The first radials have a length greater than the width and have nearly parallel sides. The facets for the articulation of the second radials are very small. The vault is unknown.

The general form will distinguish this species from all others, beside, the surface ornamentation is quite peculiar.

Found by R. A. Blair in the chert belonging to the Burlington Group, at Sedalia, Missouri, and now in the collection of S. A. Miller.

PLATYCRINUS MODESTUS, n. sp.

Plate IV, Fig. 43, side view; Fig. 44, basal view; Fig. 45, Summit view, of the same specimen.

We have several specimens of this species, but they are all casts. The species is below medium size. The calyx is bowl-shaped, pentagonal, and about one-third wider than high. It is constricted below the arms. There are no indications of any ornamentation.

Basals form a nearly flat, pentagonal disc. The first radials have a width a little greater than the length and they expand moderately upward. The superior angles are strongly truncated for the reception of the interradials. The facets for the articulation of the second radials are not preserved, but the ambulacral canals make a delicate notch in the middle of each first radial.

The vault is elevated and convex, the first interradials are large and stand nearly upright, but curve the superior end slightly over on the vault. The ambulacral canals are remarkably deep and form elevated rounded ridges on the summit of the vault; in other words, they cut the first radials and form the highest part of the vault. The vault is covered with polygonal plates, the central one being about as large as an interradial. The proboscis is sub-central.

While there are some pentagonal, bowl-shaped species that the calyx of this species resembles, there are none described having any such vault as this one has.

Found in the chert belonging to the Burlington Group at Sedalia, Missouri, and now in the collection of S. A. Miller.

PLATYCRINUS GERMANUS, n. sp.

Plate IV, Fig. 46, side view, the spines may be foreign matter; Fig. 47, basal view, one plate is pushed a little out of place, and the spines on one belong to foreign material.

Species medium size. Calyx somewhat obpyramidal, rather rapidly expanding especially toward the arm bases, which gives to the upper part a pentagonal outline; truncated below, only to the extent of the diameter of the column; diameter about one-half more than the height; surface granular.

Basals form a cup two and a half times the diameter of the column, the lower part having a concave depression for the attachment of this column without any surrounding rim. The facets supporting the radials are slightly concave. First radials a little longer than wide, gradually expanding, convex longitudinally, depressed towards the sutures, and most tumid toward the second radials. Articulating facets directed upward at an angle of about forty-five degrees, form more than half a circle, and occupy about half the diameter of each plate. Only slightly notched in the central part. Second radials short and axillary.

Vault elevated, the first interradials standing nearly upright. There are a few large spines on the summit of the specimen, but as the outlines of the plates cannot be determined it is not certain that the spines belong to it, probably they belong to foreign matter.

This species is distinguished from *P. æquiternus*, which it most resembles, by the form of the basals as well as by the proportion of the height to the diameter. The facets for the second radials are also somewhat different, and the angles for the interradials are more obtuse in that species than in this, which shows that the vaults are different, though unknown beyond those plates. It might also be compared with *P. pettisensis*, from which it may be distinguished by the form of the basal cup and the articulating facets for the second radials, and by minor details.

Found by Mr. F. A. Sampson in the Chouteau Group, at Sedalia, Missouri, and now in his collection.

FAMILY PISOCRINIDÆ.

PISOCRINUS BACCULA, n. sp.

Plate V, Fig. 23, side view showing the small single radial; Fig. 24, side view showing the large radial; Fig. 25, basal view; Fig. 26, summit view of calyx.

Species large, quite as large as *P. campana*. Calyx somewhat bell-shaped or like a huckleberry; greatest diameter at the lower third and below the point of the small radial; abruptly rounded below and deeply concave or sunken at the columnar pit; rapidly contracted in the upper part. The specimen illustrated is not round, as seen from below, and all three of the specimens examined seem to be somewhat irregular in this respect, though each of the others is more nearly round and regular than the one illustrated. Plates thick. Surface smooth.

The five basals form almost an equilateral triangle that is not visible in a side view except at the angle below the small radial. They are abruptly bent down into the columnar cavity. The three plates in the angles are quadrilateral, the other two are triangular. There is not much difference in the size of the basals. The positions of the subradial and the five radials are the same as in *P. gemmiformis*, the difference in size and form simply gives the difference in the shape of the calyx which is much more contracted in the superior part of this species than in that one. The form of this species is such that the arm blades must be shorter than in other species, and smaller in proportion to the size of the body, or they must spread above the mortises or articulating facets, differently from other species.

Found in the Niagara Group, near St. Paul, Indiana, and now in the collection of Wm. F. E. Gurley.

PISOCRINUS MILLIGANI, n. sp.

Plate V, Fig. 27, side view of a complete specimen which also preserves part of the column magnified two diameters; Fig. 28, basal view of the same specimen magnified two diameters. This specimen does not show the sutures in the calyx. Figs. 21, 22 and 23, on Plate VI of the 17th Report of the Geological Survey of Indiana belong to this Species.

Species medium size, larger than *P. gorbyi*, which it resembles. Calyx obpyramidal, truncated below and has a deep columnar pit, and more or less rapidly expands in the radial regions, giving to the upper part a pentalobate aspect. There is some difference among the specimens as to the proportions in length and breadth and as to the extent of the pentalobate extensions; but the specimens illustrated here and in the Indiana report are average in this respect. *P. gorbyi* is longer in proportion to the diameter than this species. Plates thick; surface smooth. Column small and round.

The five basal plates form a triangle that occupies the basal cavity and the lower part of the calyx so as to be seen in a side view even plainer than they can be in *P. gorbyi*. The subradial and radial plates are proportionally shorter and wider than in *P. gorbyi* and the lobate character more pronounced. The radials are excavated by a wide dove-tailed mortise on the lobes of the calyx, and, in the depressions between the lobes, curve in over the calyx so as to leave the summit, when the arm blades are removed, with a five-rayed star-like opening. There is no vault plate. The tenons of the blades fill the mortises, and the blades unite, leaving only a small round opening at the center, which is continued up between the blades, but it is much contracted at the summit. Each arm blade consists of a single plate. The specimen illustrated is complete.

The arm blades are larger and stronger in this species than in *P. gorbyi*, which is a marked distinction, though the shorter and wider radials will enable any one to distinguish the species, in the absence of the arm blades.

There are, in the collection of Mrs. J. M. Milligan, five specimens of this species having the arm blades, and many specimens, in which the arm blades are not preserved; there are also specimens, without the arm blades, in the collection of the authors, all of which came from Decatur county, Tennessee. It must be apparent to any one having been a student of the Echinodermata that *Pisocrinus* is not more nearly related to the order *Palæocrinoidea* than it is to the *Blastoidea*. It has neither the arms nor the vault of a crinoid, besides being anomalous, in the arrangement of the plates of the calyx.

Found by Mrs. J. M. Milligan, in the Niagara Group, of Decatur county, Tennessee. The specific name is intended as a compliment to the lady who collected the fossils from that locality and has been a student of Natural History for many years.

THALAMOCRINIDÆ, n. fam.

This family name is proposed to receive the new genus Thalamocrinus and for the present, the family characters must be regarded the same as the generic.

THALAMOCRINUS, n. gen.

[Ety, *thalamos* a small house or den; *krinon* lily.]

Body pear-shaped or more or less fusi form, and covered by three ranges of plates and a small vault. Basals or first circle plates five, equal. Subradials or second circle of plates five. Radials or third circle of plates six. The vault is unknown but supposed to be like the vault of *Zophocrinus*. Column small. No arms. Type *T. ovatus*.

This genus is only referred to the Palaeocrinoidea provisionally. Probably a new order should be established to include it and *Zophocrinus* and some other forms that are not very well understood.

THALAMOCRINUS OVATUS, n. sp.

Plate V, Fig. 29, side view; Fig. 30, azygous side; Fig. 31, summit view without the vault, magnified two diameters.

Body small, oval or pear-shaped, greatest diameter at the upper third; length one third more than the diameter; surface smooth.

The five basal plates are of equal size and about one-third the length of the body. They are excavated below apparently for the attachment of a column, but the columnar canal is too minute to be seen except with a strong magnifier and even then it looks like a very minute, round orifice. The second series of plates are subradial in position and alternate with the basals. They constitute a little more than half the length of the body; four of them are hexagonal and one is heptagonal. The plates in the third range are short and five of them alternate with the subradials, while one of them truncates the heptagonal plate at the top, on the azygous side. The short plates forming this circle are beveled toward the interior at the top, and present an appearance much like *Zophocrinus*, when the vault is removed in that genus, which indicates a similarity in the vaults of the two genera.

Found by Mrs. J. M. Milligan, in the Niagara Group, in Decatur county, Tennessee, and now in her collection. There are three specimens, one is smaller than the specimen illustrated, and another is more than twice as large, so that the natural size of it is as large as the illustrations.

THALAMOCRINUS CYLINDRICUS, n. sp.

Plate V, Fig. 32, side view of two ranges of plates; Fig. 33, summit view of second range, magnified two diameters.

Body small, subcylindrical or somewhat fusiform. Length more than twice the diameter. Surface smooth. Sutures very distinct and slightly beveled.

Basals of equal size and having a length equal to the diameter of the cup. Truncated below, and under an ordinary magnifier no columnar canal is visible, though there is a cicatrix for some kind of attachment. The second circle of plates alternate with the basals and form a small cylinder having a length fully equal to the diameter. The thick plates may be seen at the end and the small, round visceral cavity. The third circle or radial plates are destroyed in our specimen, but the facets for attachment are preserved and there is no reasonable doubt but that there are six of them.

Found by Mrs. J. M. Milligan, in the Niagara Group, in Decatur county, Tennessee, and now in her collection.

FAMILY UNCERTAIN.

INDIANOCRINUS, n. gen.

[Ety. proper name, *Indiana*; *Krimon*, lily.]

This genus is founded upon the calyx of a single specimen and hence there are only a few characters to be ascribed to it. Basals, five. No subradials. Primary radials one by four Arms four. No regular interradials. Azygous interradial rests between the upper sloping sides of two basals and is followed by two plates at the top of the calyx. Plates punctate. Type *I. punctatus*. This genus cannot be certainly classed in any family.

INDIANOCRINUS PUNCTATUS, n. sp.

Plate V, Fig. 8, basal view; Fig. 9, summit view; Fig. 10, lateral view, azygous side on the right; Figs. 11, 12 and 13, same views magnified two diameters.

Calyx pear-shaped; plates longitudinally convex; sutures depressed. Surface pitted or punctate. Column very small.

Basals pentagonal, elongated, truncated for a very small column and forming together a pentagonal cup, with depressed longitudinal sutures, about one-third of the height of the calyx. Primary radials longer than wide, the two adjoining the azygous area larger than the other two, most convex in the middle, at the lower edge of the articulating facets; lateral sutures deeply depressed toward the top of the calyx. Facets for the second radials a little more than one-third of the width of the plates, subelliptical in outline and deeply notched for the ambulacral canals. The angles formed, at the sutures on the superior face, between the articulating facets, are obtuse, as the superior lateral angles of the first radials curve over toward the vault.

The first azygous plate is hexagonal, as wide as long, very tumid or bulged out in the central part, rests between the upper sloping sides of two basals, separates two first radials and is followed by two plates that are not preserved in our specimen. The two superior faces are concave. The vault is unknown.

This species is extraordinary because there are only four arms; because the first azygous plate rests between the upper sloping sides of two basals, and because the plates are pitted. The specimen is well preserved and in its normal condition. The hole shown in the illustrations does not appear to pass through the test and may not properly belong to the species as a character of any importance.

Found in the Niagara Group, at St. Paul, Indiana, and now in the collection of Wm. F. E. Gurley.

ORDER CYSTOIDEA.

FAMILY HOLOCYSTIDÆ.

HOLOCYSTITES ASPER, n. sp.

Plate V, Fig. 1, *summit view; Fig. 2, anterior side view.*

Body medium size, subovate most tumid on the left anterior side, plates large, convex, covered with large pastules and pierced with numerous pores; sutures deeply impressed. The specimen illustrated has the lower part broken away, so whether or not it was sessile cannot be determined, and probably two ranges of plates are gone; five ranges of plates only are preserved.

The first range of plates preserved, which is, in fact, the second or third range, consists of four large plates and four smaller ones, the latter are on the anterior side and may be seen at the bottom of figure 2. The second range has eleven plates, of unequal size; the third range has eleven plates, the fourth range six, and the fifth range, that surrounds the ambulacral orfice, at the center of the summit, has six plates. There are no intercalated plates between the ranges in our specimen.

The mouth is surrounded by five plates and is submarginal between the range that surrounds the ambulacral orifice and the next range below. Four of the plates that scrround the ambulacral orfice have spine bases.

This specimen will be distinguished by its general rough form, flattened or depressed anterior side, ventricose upper part of the left anterior side, increased size and irregular outline of plates to cover the ventricose parts of the body without its intercalation of small plates between the ranges, by the number of plates in the ranges, and by the four spine-bearing summit plates. If two ranges of plates are broken off from the lower part then it is, probably, nearer to *H. ornatissimus*, than to any other species, agreeing with it in the number of ranges of plates and summit spines, but differing in the shape of the body, the position of the greater tumidity, and in the number of plates in each of the ranges below the summit.

Found in the lower part of the Niagara Group near Madison, Indiana, and now in the collection of J. F. Hammell.

HOLOCYSTITES SPHAEROIDALIS, n. sp.

Plate V, Fig. 3, summit view; Fig. 4, left side view.

Species sessile, with a large subelliptical base of attachment, that is very short. Body medium or below medium size, subspheroidal, though bulging on different parts, most tumid in the left posterior part, where it is peculiarly prolonged Plates small in the lower part, but medium size above, very slightly convex in part and plane in part, and pierced with numerous pores without any order of arrangement. Sutures not beveled and traced with some difficulty.

The first range of plates above the solid base of attachment is composed of very short, wide plates that are interrupted in the posterior part, so as not to make a complete circle. The second range is composed of small plates that are longer than wide on the front and sides, but wider on the posterior part, and form a complete circle. The third range is similar to the second, but the plates are longer. In the fourth range there are twenty-seven plates, differing somewhat in size, but all of them rather larger than wide. In the seventh range sixteen plates, four of which abut upon the oral opening or mouth, as shown in figure 3, and there is a small triangular plate that abuts upon the mouth and cuts off an angle from two of these plates. The eighth range surrounds the ambulacral

THALAMOCRINUS OVATUS, n. sp.

Plate V, Fig. 29, side view; Fig. 30, azygous side; Fig. 31, summit view without the vault, magnified two diameters.

Body small, oval or pear-shaped, greatest diameter at the upper third; length one third more than the diameter; surface smooth.

The five basal plates are of equal size and about one third the length of the body. They are excavated below apparently for the attachment of a column, but the columnar canal is too minute to be seen except with a strong magnifier and even then it looks like a very minute, round orifice. The second series of plates are subradial in position and alternate with the basals. They constitute a little more than half the length of the body; four of them are hexagonal and one is heptagonal. The plates in the third range are short and five of them alternate with the subradials, while one of them truncates the heptagonal plate at the top, on the azygous side. The short plates forming this circle are beveled toward the interior at the top, and present an appearance much like *Zophocrinus*, when the vault is removed in that genus, which indicates a similarity in the vaults of the two genera.

Found by Mrs. J. M. Milligan, in the Niagara Group, in Decatur county, Tennessee, and now in her collection. There are three specimens, one is smaller than the specimen illustrated, and another is more than twice as large, so that the natural size of it is as large as the illustrations.

THALAMOCRINUS CYLINDRICUS, n. sp.

Plate V, Fig. 32, side view of two ranges of plates; Fig. 33, summit view of second range, magnified two diameters.

Body small, subcylindrical or somewhat fusiform. Length more than twice the diameter. Surface smooth. Sutures very distinct and slightly beveled.

Basals of equal size and having a length equal to the diameter of the cup. Truncated below, and under an ordinary magnifier no columnar canal is visible, though there is a cicatrix for some kind of attachment. The second circle of plates alternate with the basals and form a small cylinder having a length fully equal to the diameter. The thick plates may be seen at the end and the small, round visceral cavity. The third circle or radial plates are destroyed in our specimen, but the facets for attachment are preserved and there is no reasonable doubt but that there are six of them.

Found by Mrs. J. M. Milligan, in the Niagara Group, in Decatur county, Tennessee, and now in her collection.

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[Ety. proper name, *Indiana*; *Krimon*, lily.]

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INDIANOCRINUS PUNCTATUS, n. sp.

Plate V, Fig. 8, basal view; Fig. 9, summit view; Fig. 10, lateral view, azygous side on the right; Figs. 11, 12 and 13, same views magnified two diameters.

Calyx pear-shaped; plates longitudinally convex; sutures depressed. Surface pitted or punctate. Column very small.

Basals pentagonal, elongated, truncated for a very small column and forming together a pentagonal cup, with depressed longitudinal sutures, about one-third of the height of the calyx. Primary radials longer than wide, the two adjoining the azygous area larger than the other two, most convex in the middle, at the lower edge of the articulating facets; lateral sutures deeply depressed toward the top of the calyx. Facets for the second radials a little more than one-third of the width of the plates, subelliptical in outline and deeply notched for the ambulacral canals. The angles formed, at the sutures on the superior face, between the articulating facets, are obtuse, as the superior lateral angles of the first radials curve over toward the vault.

The first azygous plate is hexagonal, as wide as long, very tumid or bulged out in the central part, rests between the upper sloping sides of two basals, separates two first radials and is followed by two plates that are not preserved in our specimen. The two superior faces are concave. The vault is unknown.

This species is extraordinary because there are only four arms; because the first azygous plate rests between the upper sloping sides of two basals, and because the plates are pitted. The specimen is well preserved and in its normal condition. The hole shown in the illustrations does not appear to pass through the test and may not properly belong to the species as a character of any importance.

Found in the Niagara Group, at St. Paul, Indiana, and now in the collection of Wm. F. E. Gurley.

ORDER CYSTOIDEA.

FAMILY HOLOCYSTIDÆ.

HOLOCYSTITES ASPER, n. sp.

Plate V, Fig. 1, *summit view; Fig. 2, anterior side view.*

Body medium size, subovate most tumid on the left anterior side, plates large, convex, covered with large pastules and pierced with numerous pores; sutures deeply impressed. The specimen illustrated has the lower part broken away, so whether or not it was sessile cannot be determined, and probably two ranges of plates are gone; five ranges of plates only are preserved.

The first range of plates preserved, which is, in fact, the second or third range, consists of four large plates and four smaller ones, the latter are on the anterior side and may be seen at the bottom of figure 2. The second range has eleven plates, of unequal size; the third range has eleven plates, the fourth range six, and the fifth range, that surrounds the ambulacral orfice, at the center of the summit, has six plates. There are no intercalated plates between the ranges in our specimen.

The mouth is surrounded by five plates and is submarginal between the range that surrounds the ambulacral orifice and the next range below. Four of the plates that scrround the ambulacral orfice have spine bases.

This specimen will be distinguished by its general rough form, flattened or depressed anterior side, ventricose upper part of the left anterior side, increased size and irregular outline of plates to cover the ventricose parts of the body without its intercalation of small plates between the ranges, by the number of plates in the ranges, and by the four spine-bearing summit plates. If two ranges of plates are broken off from the lower part then it is, probably, nearer to *H. ornatissimus*, than to any other species, agreeing with it in the number of ranges of plates and summit spines, but differing in the shape of the body, the position of the greater tumidity, and in the number of plates in each of the ranges below the summit.

Found in the lower part of the Niagara Group near Madison, Indiana, and now in the collection of J. F. Hammell.

HOLOCYSTITES SPHAEROIDALIS, n. sp.

Plate V, Fig. 3, summit view; Fig. 4, left side view.

Species sessile, with a large subelliptical base of attachment, that is very short. Body medium or below medium size, subspheroidal, though bulging on different parts, most tumid in the left posterior part, where it is peculiarly prolonged Plates small in the lower part, but medium size above, very slightly convex in part and plane in part, and pierced with numerous pores without any order of arrangement. Sutures not beveled and traced with some difficulty.

The first range of plates above the solid base of attachment is composed of very short, wide plates that are interrupted in the posterior part, so as not to make a complete circle. The second range is composed of small plates that are longer than wide on the front and sides, but wider on the posterior part, and form a complete circle. The third range is similar to the second, but the plates are longer. In the fourth range there are twenty-seven plates, differing somewhat in size, but all of them rather larger than wide. In the seventh range sixteen plates, four of which abut upon the oral opening or mouth, as shown in figure 3, and there is a small triangular plate that abuts upon the mouth and cuts off an angle from two of these plates. The eighth range surrounds the ambulacral orifice and consists of eight plates, five of which bear the scars of ambulacral spines, and one is inserted between the mouth and the ambulacral orifice. The mouth is submarginal, large and somewhat smaller than the very large ambulacral orifice, each is surrounded by eight plates.

This species will be distinguished by its general form, great number of plates, none of which are intercalated, except the triangular one that abuts upon the mouth, eight ranges, five spine bases, and sessile habit.

Found in the lower part of the Niagara Group near Madison, Indiana, and now in the collection of Mr. J. F. Hammell.

ORDER BLASTOIDEA.

FAMILY CODASTERIDÆ.

CODASTER BLAIRI, n. sp.

Plate V, Fig. 20, basal view; Fig. 21, side view; Fig. 22, summit view, one triangular field is covered with part of the matrix so that the azygous opening cannot be seen.

Calyx obpyramidal, summit convex, so that the total length, from column to summit, is equal to the greatest diameter. Transverse section of the calyx pentagonal with slightly concave sides; surface marked with numerous fine lines parallel to the sutures between the plates, except the three longitudinal sutures between the basals. Truncated at the base for a very small, round column.

There are three basals, the two larger ones are of equal size and pentagonal, the smaller one is tetragonal and each has its inner apex notched to form part of the round columnar canal. The basals form a pentagonal cup about half the height of the calyx. Radials a little wider than high, equal, truncated above, and mesial gibbosity gives the pentagonal outline to the summit. From a central, pentagonal, stelliform opening, five triangular fields radiate to the angles of the pentagonal summit. The one which is smooth and bears the anal opening, in other species, has part of the matrix attached to it in our specimen, so the anal orifice cannot be distinguished. Each of the other four triangular fields is divided by a narrow angular radiating ridge that terminates at the lateral suture between the first radials called the "oral ridges." The pseudoambulacra are narrow and each one shows a dividing line or furrow from the central oral opening half way to the angles of the pentagon. There are eight hydrospire slits in each of the eight areas between the oral ridges and the pseudoambulacra.

The general form and eight hydrospire slits in each field will distinguish this species.

Found by R. A. Blair, in whose honor the specific name is proposed, in the Chouteau limestone near Sedalia, Missouri, and now in the collection of S. A. Miller.

SUBKINGDOM CŒLENTERATA.

CLASS ANTHOZOA.

SUBCLASS ZOANTHARIA.

FAMILY ZAPHRENTIDÆ.

HADROPHYLLUM TENNESSEENSE, n. sp.

Plate V, Fig. 16, summit view of a slightly convex specimen; Fig. 18, summit view of a more convex specimeu; Fig. 17, lateral view of same; Fig 19, basal view.

Corallum medium size, short, longitudinally double convex, transversely elliptical. Calyx convex, sometimes very highly convex and having a flattened or slightly concave central area, the greater convexity is opposite the septal fossette and above the place of attachment or commencement of growth. A thickened septa occupies the center of the septal fossette running with the longer diameter of the calyx from the central part to the border; the septal fossette extends around the central end of the thickened septa and its sides, from which the lateral septa radiate to the border. The lateral fossettes are inconspicuous, but are indicated by a depression from the center to the lateral borders. The radiating septa are unequally developed, those upon the sides of the septal fossette are much shorter than the others. There are from twenty-two to twenty-six in the specimens examined. The point of attachment or place of commencement of growth is subcentral or below one of the foci of the ellipse formed by the calicular border. From a short elliptical base the corallum is abruptly expanded to the calicular border.

The length of a specimen is about three-tenths of an inch; shorter diameter of the calyx about four-tenths of an inch, and longer diameter of the calyx about six-tenths of an inch. Our specimens are silicified and do not show any epitheca, dissepiments, tabulæ or columella.

Found in the Silicified Subcarboniferous beds of Lincoln county, Tennessee, which we suppose are of the age of the Keokuk Group, and now in the collection of Wm. F. E. Gurley.

CLASS, CEPHALOPODA.

ORDER, NAUTILOIDEA.

FAMILY CYRTOCERATIDÆ.

CYRTOCERAS KANSASENSE, n. sp.

Plate V, Fig. 5, ventral view; Fig. 6, lateral view; Fig. 7, position of the siphuncle and convexity of the septa at the fifth air chamber that is preserved, in the specimen illustrated.

Our specimen is not complete and shows the siphuncle and convexity of the septa at the small end; and has been broken at the fifth septa, so that it may be examined in two places, and figure 7 is taken from a view at the fifth septa.

The shell rapidly expands, is gently curved, and slightly depressed from a true circle, in tranverse section, on the ventral side. The outer shell is preserved forward of the fifth septa, so that only five air chambers can be seen, but the end of the siphuncle indicates there are air chambers forward of that point. The siphuncle is small and near the vental side, the expansion within the air chambers is not disclosed. The convexity of the septa is rather more than the length of an air chamber. The septa are distant about one-fifth the diameter of the shell. The outer shell is transversely furrowed. On the ventral side the spaces between the furrows are flattened and wider than the furrows. On the dorsal side the furrows and ridges are subequal. The body chamber is not completely preserved, and the aperture, therefore, is unknown.

This species is quite distinct from all others in almost every respect and may not belong to *Cyrtoceras*. When compared with *C. dilatatum*, it will be noticed that the surface is furrowed instead of imbricated and the septa are not half as numerous. It is not necessary to draw comparisons with other species.

Found in the Upper Coal Measures, at Kansas City, Missouri, and now in the collection of Wm. F. E. Gurley.

SUBKINGDOM ARTICULATA.

CLASS ANNELIDA.

ORDER TUBICOLA.

FAMILY SERPULIDÆ.

SPIRORBIS BLAIRI, n. sp.

Pplate V, Fig. 15, a coil attatched to Platystoma broadheadi; Fig. 14, an old specimen with the anterior end prolonged upward.

Shell sinistral and in its young state attached throughout its length. Umbilicus wide. Surface marked with unequally distant rings of growth. In an old specimen, as shown by Figure 14, the anterior end is prolonged and stands upright. The lower side of the shell, that attached to some foreign object is flattened, otherwise a transverse section is circular. The aperture seems, in all stages of growth, to have been directed upward and when a complete coil, for attachment, had been formed the further growth was in the form of a loose spiral or upright tube.

Five specimens belonging to this species have been examined and the growth of the spiral in all cases, was to the left as sinistral. About one coil and a quarter or less than one turn and a half attached to the foreign substance. The transverse ridges are closer and finer on some specimens than upon others, but always more or less irregular, and sometimes quite coarse and wavy, indicating lines of growth, rather than surface ornamentation.

This species is distinguished by its sinistral growth, freedom towards the aparture, and surface lines of growth.

Found in the Chouteau limestone, at Sedalia, Missouri, and now in the collection of S. A. Miller. The specific name is in honor of R. A. Blair, the original collector.

PLATE I.

PAGE.

Batocrinus polydactylus, n. sp. 5
Fig. 1. View showing calyx, arms and part of column.

Batocrinus sampsoni, n. sp. 7
Fig. 2. View of calyx and arms.
Fig. 3. Lateral view of another specimen.

Batocrinus veterator, n. sp. 8
Fig. 4. View showing calyx and arms.

Batocrinus vetustus, n. sp. 10
Fig. 5. Azygous side view.
Fig. 6. View opposite azygous side.

Batocrinus venustulus, n. sp. 12
Fig. 7. Azygous side view of a specimen showing calyx and arms.

Batocrinus insuetus, n. sp. 14
Fig. 8. Azygous view.
Fig. 9. Calyz, proboscis and arms of same.

Batocrinus broadheadi, n. sp. 15
Fig. 10. Basal view of a calyx.
Fig. 11. Lateral view of the same.

Batocrinus nitidulus, n. sp. 17
Fig. 12. Azygous side view of a calyx.
Fig. 13. Opposite side of same.

Batocrinus peculiaris, n. sp. 18
Fig. 14. Azygous side view of a calyx.
Fig. 15. Basal view of the same.
Fig. 16. Summit view of the same.

Batocrinus imparilis, n. sp. 20
Fig. 17. Azygous view of a calyx.
Fig. 18. Opposite view of the same.

Batocrinus incultus, n. sp. 21
Fig. 19. Azygous view.
Fig. 20. Opposite view.

Batocrinus insperatus, n. sp. 22
Fig. 21. Azygous view.
Fig. 22. Opposite view.

Batocrinus formaceus, n. sp. 24
Fig. 23. Azygous view.
Fig. 24. Opposite view.

Batocrinus inconsuetus, n. sp. 25
Fig. 25. Basal view.
Fig. 26. Lateral view.
Fig. 27. Summit view.

Batocrinus serratus, n. sp. 27
Fig. 28. Basal view.
Fig. 29. Lateral view.
Fig. 30. Summit view.

Batocrinus ignotus, n. sp. 28
Fig. 31. Basal view.
Fig. 32. Lateral view.
Fig. 33. Summit view.

Batocrinus modestus, n. sp. 30
Fig. 34. Basal view.
Fig. 35. Lateral view.
Fig. 36. Summit view.

Batocrinus heteroclitus, n. sp. 31
Fig. 37. Basal view.
Fig. 38. Lateral view.
Fig. 39. Summit view.

Batocrinus procerus, n. sp. 33
Fig. 40. Basal view.
Fig. 41. Lateral view.
Fig. 42. Summit view.

ILL. STATE MUS. OF NAT. HIST.

Bulletin No. 7. **Plate I.**

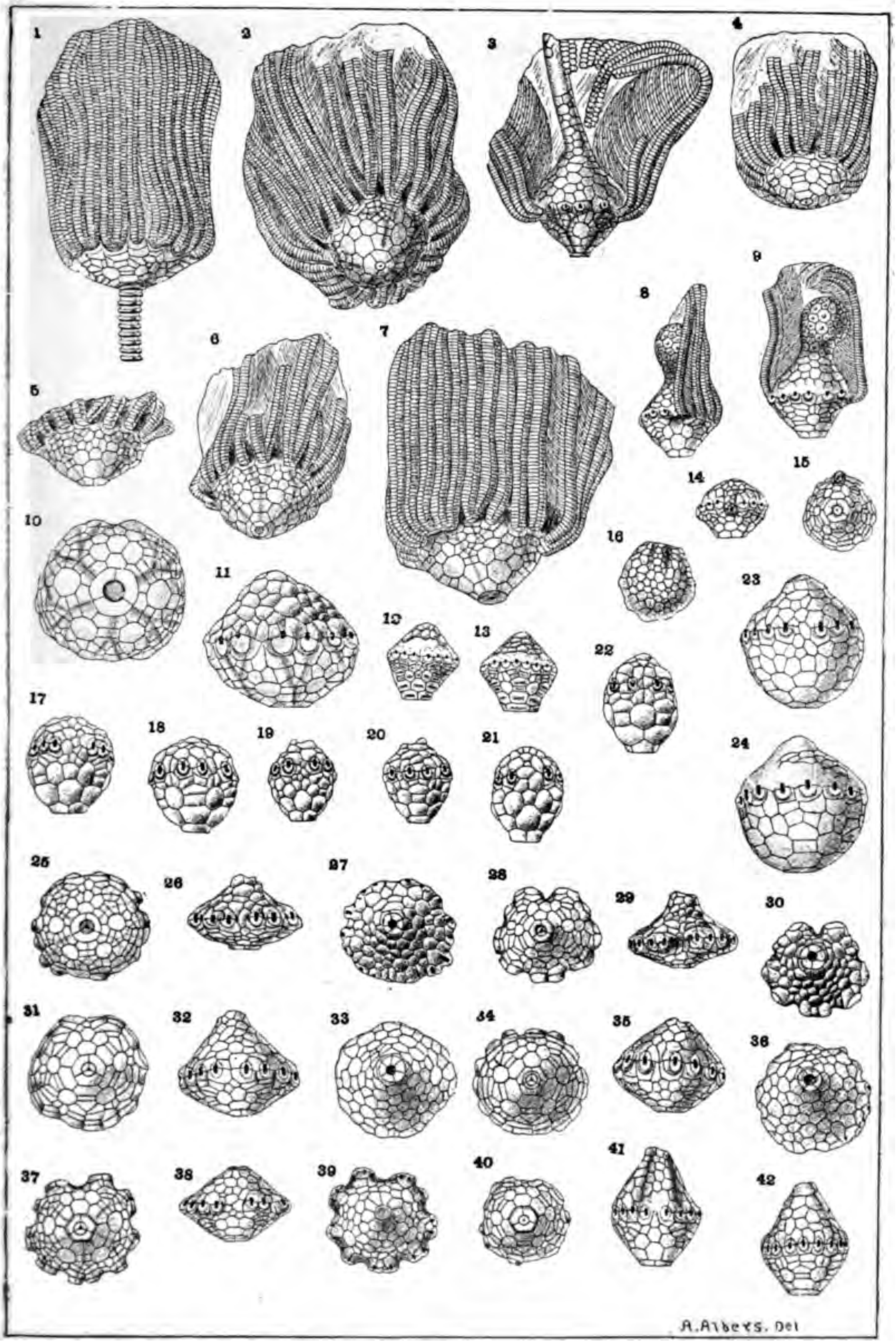


PLATE II.

PAGE.

BATOCRINUS VICINUS, n. sp. 34
Fig. 1. Basal view.
Fig. 2. Lateral view.
Fig. 3. Summit view.

BATOCRINUS INOPINATUS, n. sp. 36
Fig. 4. Basal view.
Fig. 5. Lateral view.
Fig. 6. Summit view.

BATOCRINUS PLANUS, n. sp 37
Fig. 11. Basal view.
Fig. 12. Summit view.
Fig. 13. Lateral view.
Fig. 14. Basal view of another specimen.

SHUMARDOCRINUS CONCINNUS, n. sp. 41
Fig. 7. Basal view.
Fig. 8. Summit view.
Fig. 9. Lateral view.
Fig. 10. Azygous side view.

MEGISTOCRINUS ORNATUS, n. sp. 42
Fig. 15. Basal view, azygous side up.
Fig. 16. Azygous side view.
Fig. 17. Summit view.

MEGISTOCRINUS HEMISPHERICUS, n. sp. 44
Fig. 18. Basal view, azygous side up.
Fig. 19. Azygous side view.
Fig. 20. Summit view.

ACTINOCRINUS ALBERSI, n. sp 46
Fig. 21. Azygous side view.
Fig. 22. Opposite side of same.
Fig. 23. Summit view.

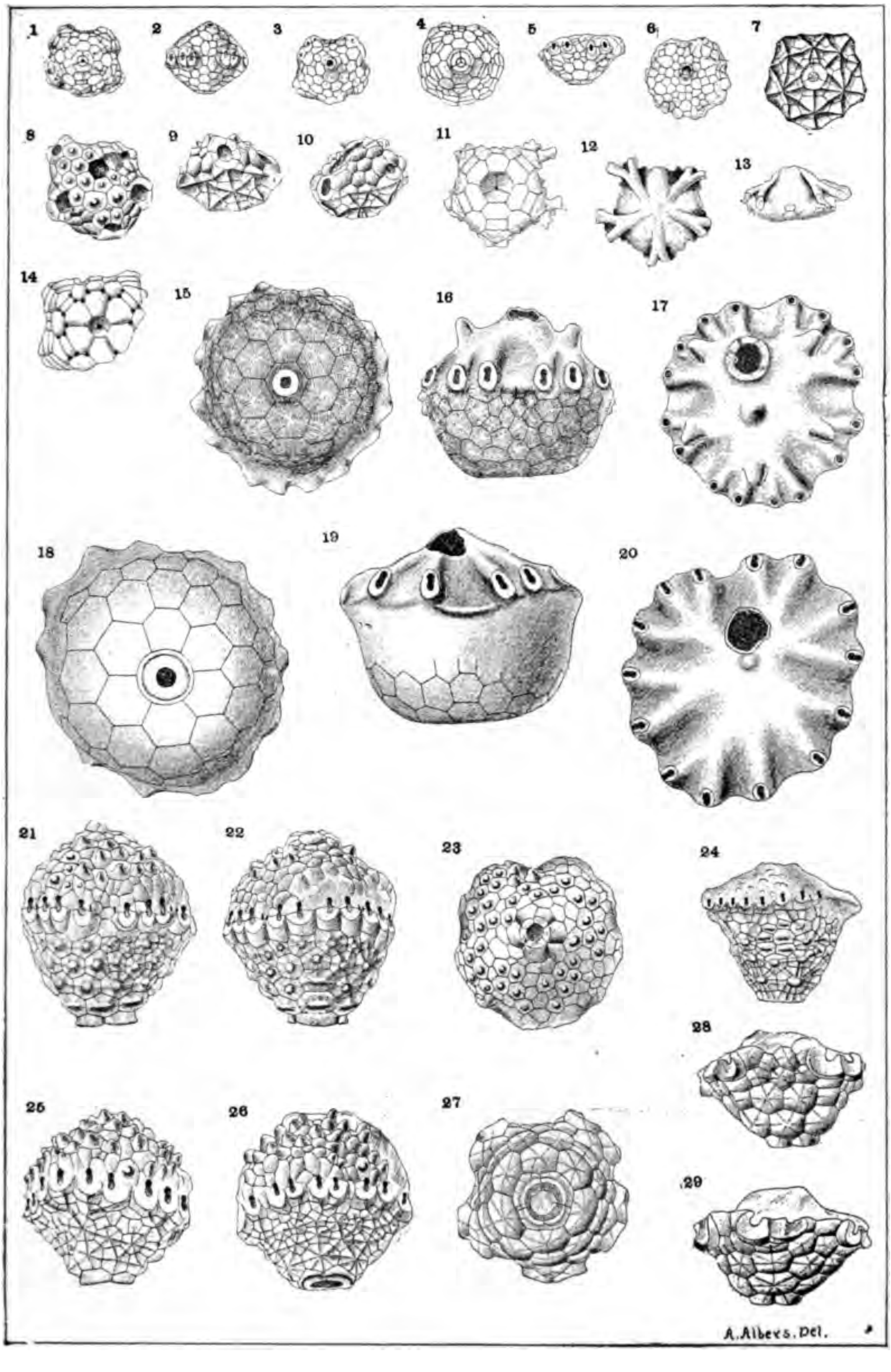
ACTINOCRINUS FOVEATUS, n. sp. 49
Fig. 25. Azygous side view.
Fig. 26. Opposite side of another specimen.

STROTOCRINUS BLAIRI, n. sp. 48
Fig. 24. Lateral view of a calyx.

MELOCRINUS SAMPSONI, n. sp. 55
Fig. 27. Basal view.
Fig. 28. Azygous side view.
Fig. 29. Opposite side of same.

ILL. STATE MUS. OF NAT. HIST.

Bulletin No. 7. **Plate II.**



A. Albers, Del.

PLATE III.

PAGE.

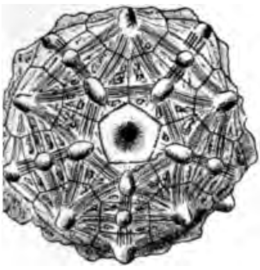
Batocrinus prodigialis, n. sp. 39
Fig. 4. Basal view.
Fig. 5. Azygous side view.
Fig. 6. Summit view.

Sampsonocrinus hemisphericus, n. sp 56
Fig. 7. Basal view.
Fig. 8. Summit view.
Fig. 9. Azygous side view.
Fig. 10. Lateral view.

Dolatocrinus nodosus, n. sp. 56
Fig. 1. Basal view.
Fig. 2. Azygous side view.
Fig. 3, Summit view.

Dolatucrinus sacculus, n. sp. 58
Fig. 11. Basal view.
Fig. 12. Azygous side view.

Dolatocrinus salebrosus, n. sp. 59
Fig. 13. Basal view.
Fig. 14. Lateral view.
Fig. 15. Summit view.



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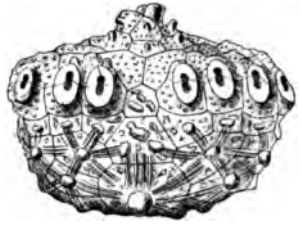

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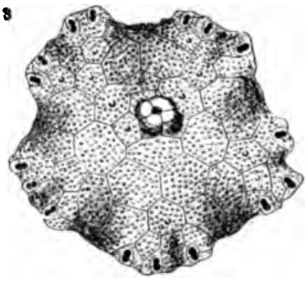

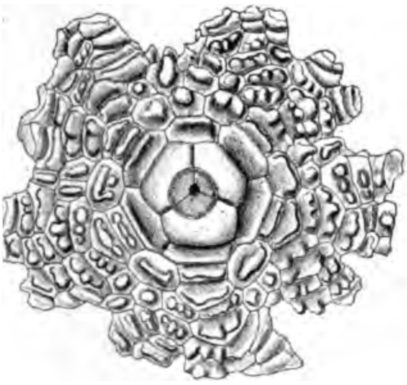

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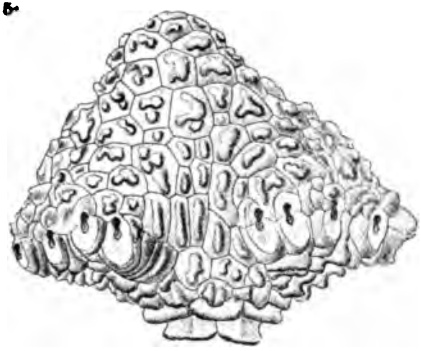

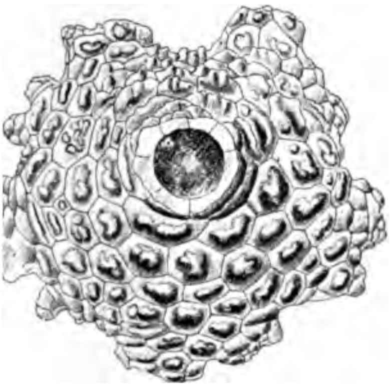

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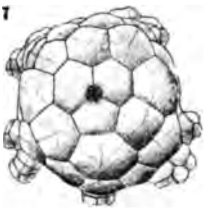

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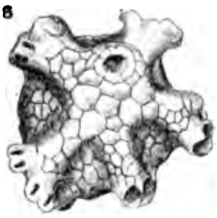

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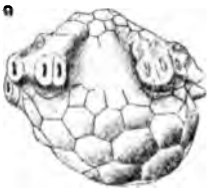

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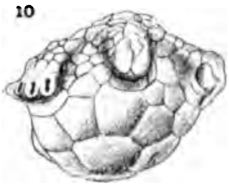

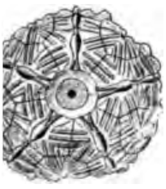

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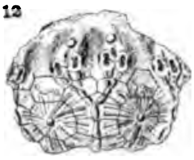

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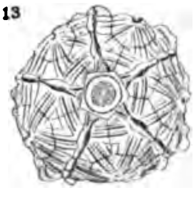

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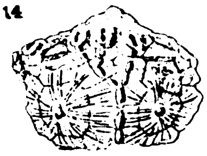

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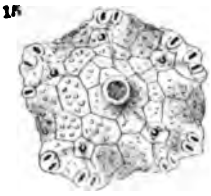

A. Albers Del

PLATE IV.

PAGE.

POTERIOCRINUS BLAIRI, n. sp. 61
Fig. 1. Azygous side view.
Fig. 2. Opposite side view.

POTERIOCRINUS ALTONENSIS, n. sp. 62
Fig. 3. Calyx and arms azygous side on the right.
Fig. 4. Opposite side of same.

POTERIOCRINUS BROADHEADI, n. sp. 63
Fig. 7. Azygous side view of calyx.
Fig. 8. Opposite side of same.

POTERIOCRINUS SAMPSONI, n. sp. 65
Fig. 9. Azygous side view of calyx.
Fig. 10. Opposite side of same.

ZEACRINUS BLAIRI, n. sp. 66
Fig. 5. View of azygous side.
Fig. 6. Opposite view of same.

CYATHOCRINUS BLAIRI, n. sp. 67
Fig. 11. Basal view, azygous side up.
Fig. 12. Azygous side view.
Fig. 13. Basal view of another specimen.
Fig. 14. Azygous side view of the same.
Fig. 15. Lateral view of same.

CYATHOCRINUS CHOUTEAUENSIS, n. sp. 68
Fig. 16. View of a calyx and part of arms, azygous side on the right.

CYATHOCRINUS MACADAMSI, n. sp 69
Fig. 31. Calyx and part of arms, azygous side on the right.
Fig. 32. Lateral view of the same.

CYATHOCRINUS BRITTSI, n. sp. 70
Fig. 35. Basal view of calyx.
Fig. 36. Azygous side of same.

PLATYCRINUS TUGURIUM, n. sp 70
Fig. 17. Basal view.
Fig. 18. Azygous side view.
Fig. 19. Summit view.

PLATYCRINUS FORMOSUS, n. sp 72
Fig. 20. Basal view.
Fig. 21. Azygous side view.

PLATYCRINUS MISSOURIENSIS, n. sp 73
Fig. 22. View of longer side.
Fig. 23. View of shorter side.

PLATYCRINUS PETTISENSIS, n. sp 73
Fig. 24. Basal view.
Fig. 25. Lateral view.

PLATYCRINUS CLINATUS, n. sp 74
Fig. 26. Shorter side view.
Fig. 27. Longer side view.
Fig. 28. Longer side of another specimen.
Fig. 29. Shorter side of same.
Fig. 30. Longer side of another specimen.

PLATYCRINUS SULCIFERUS, n. sp 75
Fig. 33. Basal view.
Fig. 34. Lateral view.

PLATYCRINUS CASULA, n. sp 76
Fig. 37. Basal view.
Fig. 38. Azygous side view.
Fig. 39. Opposite side of same.
Fig. 40. Summit view.

PLATYCRINUS SEMIFUSUS, n. sp 77
Fig. 41. Lateral view.
Fig. 42. Basal view.

PLATYCRINUS MODESTUS, n. sp 77
Fig. 43. Lateral view.
Fig. 44. Basal view.
Fig. 45. Summit view.

PLATYCRINUS GERMANUS, n. sp 78
Fig. 46. Lateral view.
Fig. 47. Basal view.

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ulletin No. 7. **Plate IV.**

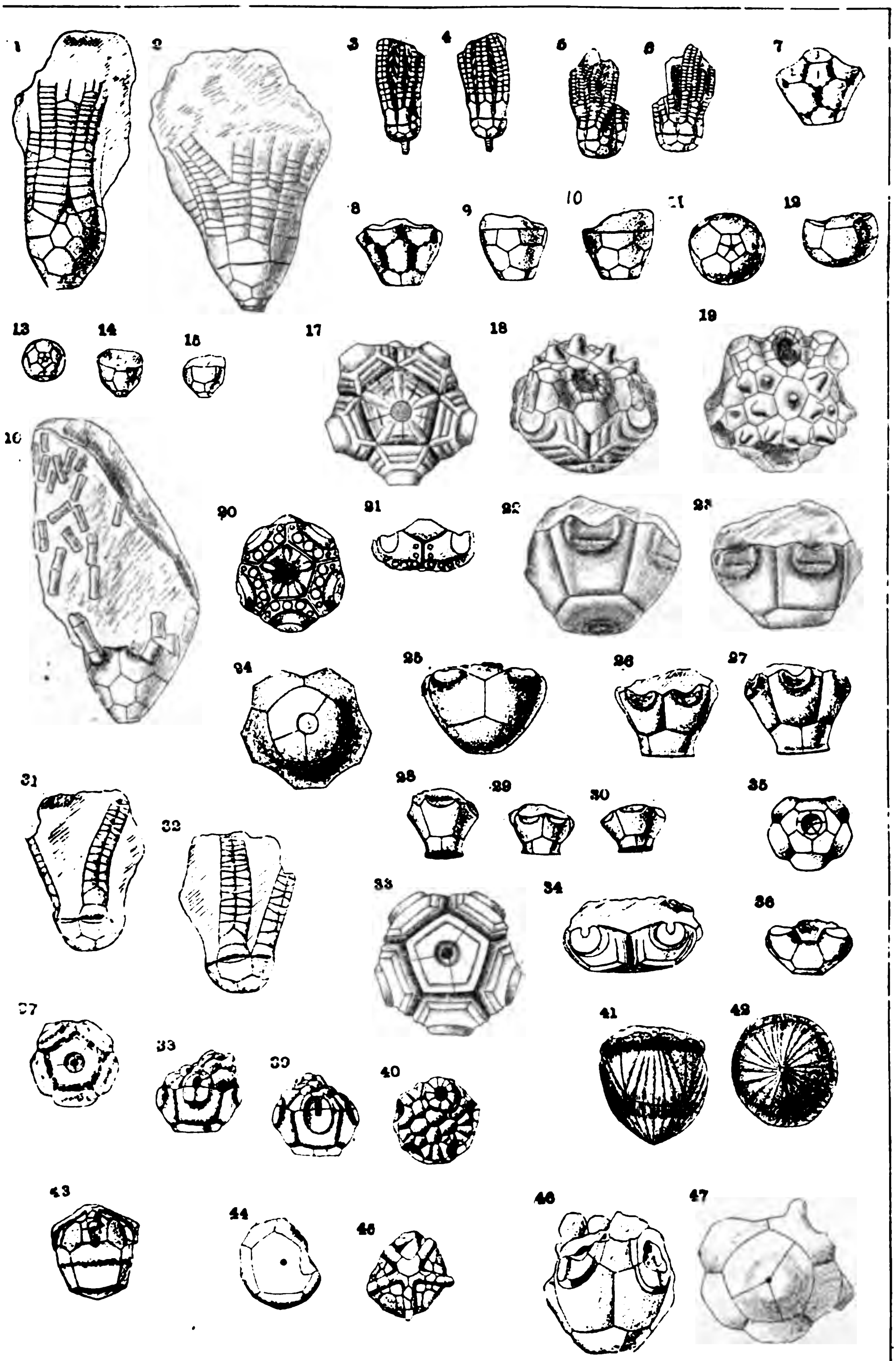

PLATE V.

PAGE.

HOLOCYSTITES ASPER, n. sp. 84

Fig. 1. Summit view.
Fig. 2. Anterior view.

HOLOCYSTITES SPHAEROIDALIS, n. sp. 85

Fig. 3. Summit view.
Fig. 4. Left side view.

CYRTOCERAS KANSASENSE, n. sp. 86

Fig. 5. Ventral view.
Fig. 6. Lateral view.
Fig. 7. Showing septa and siphuncles.

INDIANOCRINUS PUNCTATUS, n. sp. 88

Fig. 8. Basal view.
Fig. 9. Summit view.
Fig. 10. Lateral view.
Figs. 11, 12, 13. Same views magnified two diameters.

SPIRORBIS BLAIRI, n. sp. 89

Fig. 14. A specimen attached to a *Platystoma*.
Fig. 15. An older example.

HADROPHYLLUM TENNESSEENSE, n. sp. 87

Fig. 16. Summit view.
Fig. 18. Summit view of another specimen.
Fig. 17. Lateral view of the same.
Fig. 19. Basal view of same.

CODASTER BLAIRI, n. sp. 86

Fig. 20. Basal view.
Fig. 21. Lateral view.
Fig. 22. Summit view.

PISOCRINUS BACCULA, n. sp. 79

Fig. 23. Lateral view, showing small radial.
Fig. 24. Lateral view showing large radial.
Fig. 25. Basal view.
Fig. 26. Summit view, all magnified two diameters.

PISOCRINUS MILLIGANI, n. sp. 80

Fig 27. Lateral view, magnified two diameters.
Fig. 28. Basal view of same.

THALMOCRINUS OVATUS, n. sp. 82

Fig. 29. Lateral view, magnified two diameters.
Fig. 30. Azygous side view of the same.
Fig. 31. Summit view of same.

THALMOCRINUS CYLINDRICUS, n. sp. 82

Fig. 32. Lateral view, magnified two diameters.
Fig. 33. Showing summit of second range of plates.

AMPHORACRINUS SEDALIENSIS, n. sp. 54

Fig. 34. Summit view of a small specimen.
Fig. 35. Azygous side view of another specimen.
Fig. 36. Basal view of the same.
Fig. 37. Summit view of same.

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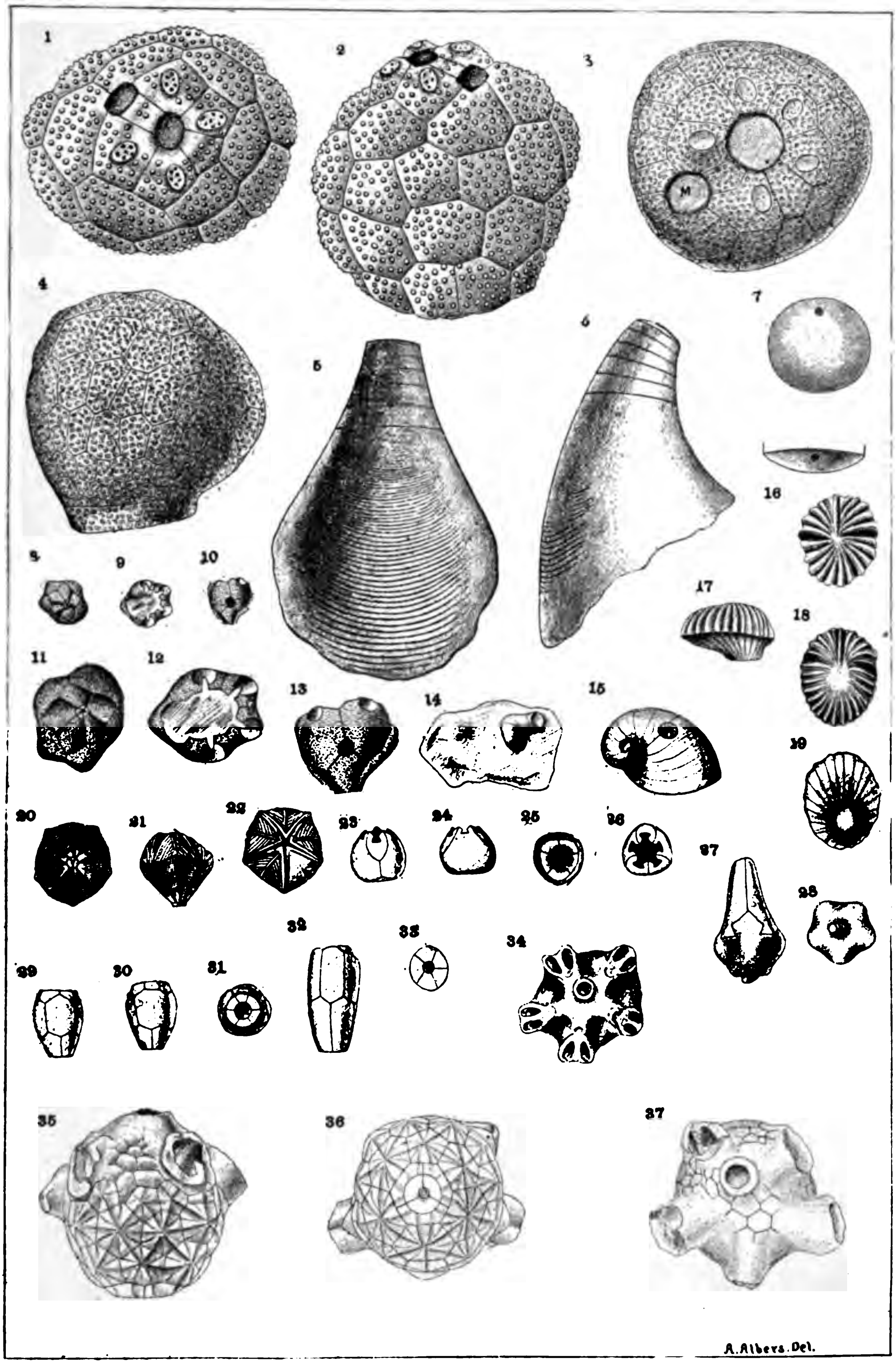
Bulletin No. 7. **Plate V.**



BULLETIN NO. 8

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DESCRIPTION OF NEW AND REMARKABLE FOSSILS FROM THE PALÆOZOIC ROCKS OF THE MISSISSIPPI VALLEY.

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DESCRIPTION OF NEW AND REMARKABLE FOSSILS, FROM THE PALÆOZOIC ROCKS OF THE MISSISSIPPI VALLEY.

BY S. A. MILLER AND WM. F. E. GURLEY.

SUBKINGDOM ECHINODERMATA.

CLASS CRINOIDEA.

ORDER PALÆOCRINOIDEA.

FAMILY ACTINOCRINIDÆ.

BATOCRINUS GERMANUS, n. sp.

Plate I, Fig. 1, basal view; Fig. 2, azygous side, some of the plates of the vault broken away; Fig. 3, summit view of the same specimen.

Body medium size, calyx and vault subequal, giving it a biturbinate or lenticular shape. Calyx moderately truncated at the base, rapidly spreading and about two and a half times as wide as high; arm openings directed nearly horizontally or directed upward at an angle of only a few degrees; plates thick, very highly convex, this convexity on the radial plates being transverse and angular. No radial ridges. Surface granular.

Basals very short, forming an hexagonal disc, with slight re-entering angles, deeply notched at the sutures, and projecting cuneiform edges a little below the end of the column, and having a round, deep, columnar depression for the attachment of the column. The basal disc is about one-half wider than the diameter of the column. The sutures are notched or beveled nearly to the first radials, and the columnar cavity is deeper. First radials about one-half wider than long, three hexagonal, two heptagonal, with the superior sides slightly arcuate. Each one is transversely convex, the elevation being obtusely angular. Second radials quadrangular, and from one-half to twice as wide as long. Third primary radials rather smaller than the second, pentagonal, axillary, and bear upon each superior sloping side two secondary radials. The second secondary radials are axillary, and, in three of the rays, bear upon each superior sloping side a single tertiary radial, which gives to each of these rays four arms. The distal side of each ray adjoining the azygous area is constructed in the same way, but the proximal side of each bears an axillary, tertiary radial that bears single quaternary plates, which arrangement gives to each of these rays five arms. There are, therefore, twenty-two arms in this species.

There are three regular interradials in each area, one, followed by two in the second range, which are cut off from the plates of the vault by the union of the tertiary radials. The azygous area is large and subovate. The first plate is in line with the first primary radials and fully as large. It is followed by three rather large plates, in the second range, three somewhat smaller, in the third range, and these by two smaller ones, in the fourth range, that unite with a single, elongated plate belonging to the vault.

The vault is covered with large, convex, polygonal plates and bears a subcentral proboscis. The proboscis commences with rather large tumid plates, but its length is unknown.

In general form this species bears most resemblance to *B. discoideus*, but that species has only a single regular interradial in each area, and only seven plates in the azygous area, which is cut off from the vault by the union of the radial plates. All other species from the Burlington Group having twenty-two arms, heretofore described, are *B. aspratilis*, *B. formosus*, *B. laetus*, *B. lepidus*, *B. sinnosus*, *B. turbinatus*, and *B. turbinatus var. elegans*. While all these species may be distinguished by the general form, proportional size of the plates and surface characters, they may also be distinguished by the interradial and azygous areas. In *B. aspratilis*, there is a single large tumid plate in each regular area, and only five plates in the azygous area, four of which are subequal in size, and the other one is a small, quadrangular plate separating them and resting on the first azygous plate. In *B. formosus*, there are two plates in some of the regular areas and three in others, and eleven plates in the azygous area. In *B. laetus*, there are two plates in each regular area and six in the azygous area. In *B. lepidus*, there are three plates in some of the regular areas and four in others and twelve plates in the azygous area. In *B. sinnosus*, there are from six to eight plates in each regular area, and fifteen or sixteen in the azygous area, and all the areas connect with the vault. In *B. turbinatus*, there are three plates, one following the other, or three ranges, the middle one having two plates in each regular interradial area, and ten plates in the azygous area, the last one of which is elongated and connects with the plates of the vault. In *B. turbinatus, var. elegans*, there are three plates in each regular area, one following the other, and eight or nine plates in the azygous area. *B. aspratilis* and *B. laetus* were described from Sedalia, Missouri, and among the forms received from there we have recognized *B. discoideus* and *B. turbinatus*, which were described from Burlington, Iowa.

Found by R. S. Blair, in the Burlington Group, at Sedalia, Missouri, and now in the collection of S. A. Miller.

BATOCRINUS PROXIMUS, n. sp.

Plate I, Fig. 4, basal view; Fig. 5, side view.

Body medium size, somewhat biturbinate, though the calyx is larger than the vault. Calyx obconoidal, most rapidly spreading toward the free arms, truncated at the base, a little less than twice as wide as high; arm openings directed upward at an angle of twenty or thirty degrees; plates tumid, leaving the sutures much depressed; surface finely granular.

Basals form a short, hexagonal disc, with slight re-entering angles. The disc is notched at the sutures, and has a round, deep, columnar depression for the attachment of the column; it is less than twice the diameter of the column. The basal plates expand below and project cuneiform edges below the end of the column. First radials from one-half wider to twice as wide as long, three hexagonal, two heptagonal, with the superior edges slightly arcuate. Second primary radials quadrangular, from two to two and a half times as wide as high. Third primary radials larger than the second, pentagonal, axillary, and bear upon each superior sloping side two secondary radials. The second secondary radials are axillary, and, in three of the rays, bear upon each superior sloping side two tertiary radials, which gives to each of these rays four arms. The distal side of each ray, adjoining the azygous area, is constructed in the same way, but the proximal side of each bears an axillary, tertiary radial that supports quaternary plates, which arrangement gives to each of these rays five arms. There are, therefore, twenty-two arms in this species.

There are three regular interradials, in each area, one, followed by two of unequal size, in the second range, which are cut off from the plates of the vault by the union of the tertiary radials. The azygous area contains seven plates. The first one is in line with the first primary radials and fully as large as any of them. It is followed by three rather large plates, subequal in size, in the second range, and by three smaller plates in the third range, that are cut off from the plates of the vault by the union of the quaternary plates.

The vault is covered with highly convex or tumid polygonal plates and bears a subcentral proboscis, which is not preserved in our specimens.

The general form of this species will readily distinguish it from such twenty-two armed species as *B. discoideus*, and *B. germanus*, without calling attention to the extra tertiary radial, in each series, or the differences in the interradial areas. It is more like *B. lactus* than any other described species, but may be distinguished by the general character of the plates, which is conspicuous when the basals are compared, and by the direction of the arm openings, as well as by the interradial areas. In that species there are two regular interradials in each area, and in this species there are three. In that species there are six azygous plates, and in this species there are seven. In this species the calyx expands more rapidly than in that one, and the vault is elevated, in that species, over the arm openings more than it is in this one.

Found by R. A. Blair, in the Burlington Group, at Sedalia, Missouri, and now in the collection of S. A. Miller.

BATOCRINUS HODGSONI, n. sp.

Plate I, Fig. 6, azygous side; Fig. 7, side view. The specimen is compressed so as to widen the side view and contract the azygous view.

Species medium size, biturbinate, calyx larger than the vault. Calyx bell-shaped, rounded below and most rapidly expanding as the arms are approached; nearly as high as wide. Arm openings directed very little above a horizontal line. No radial ridges. Plates convex only in the region of the last radials. Surface smooth or finely granular.

Basals form a cup about half as high as wide and truncated by a small column and bearing a concave facet for its attachment. First radials larger than the basals and rather longer than wide, three hexagonal, two heptagonal and rising almost vertically from the basals. Second radials quadrangular, about half as wide as the first, but nearly twice as wide as long. Third radials a little larger than the second, three hexagonal, two pentagonal, axillary and bear upon each superior sloping side the secondary radials. In the ray opposite the azygous side and in one of the lateral rays there are two secondary radials, in each series, the last one much longer than the first, which gives to each of these rays two arms. In each ray adjoining the azygous area there are two secondary radials on the distal side and one on the proximal side which is axillary and bears upon each upper sloping side a single tertiary radial. One of the lateral rays is constructed in the same way. Each of these three rays bears three arms. It is also to be observed that the radials which support the arms are longer than those immediately below. There are, therefore, in this species thirteen arms.

In one of the regular interradial areas there are three plates, one followed by two in the second range. In the other areas there are only two plates, one following the other. These areas do not connect with the vault. In the azygous area there are seven plates. The first one is in line with the first primary radials and is the largest plate in the body. It is followed by three plates in the second range and three in the third range. The middle plate in the third range is elongated, separates the tertiary radials and unites with two plates belonging to the vault.

Vault elevated, convex, and bears a submarginal proboscis. It is covered with large, polygonal, smooth plates.

This is the first species of *Batocrinus* bearing only thirteen arms that has ever been described, from the Burlington Group, and its arm formula, therefore, is sufficient to distinguish it from all other species. In form, it approaches more nearly ***B. christyi***, which has twenty arms, than any other species.

Found by Mr. C. S. Hodgson, a naturalist of Albion, Illinois, in whose honor I have proposed the specific name, in the Burlington Group, in Adams County, Illinois, and now in the collection of S. A. Miller.

BATOCRINUS ARGUTUS, n. sp.

Plate I, Fig. 8, azygous side; Fig. 9, opposite view.

Body medium size, calyx and vault, subequal in size, making it biturbinate. Calyx rather broadly truncated below, and most rapidly spreading toward the free arms. About twice as wide as high. Arm openings directed nearly horizontally. No radial ridges. Plates thick and highly convex or tumid. Surface granular.

Basals form an hexagonal disc, with slight re-entering angles, deeply notched at the sutures, and project cuneiform edges, slightly expanding, below the end of the column. The basal disc is about one-half wider than the diameter of the column, and bears a deep concave depression for the attachment of the column. First radials about one-half wider than long, three hexagonal, two heptagonal, and transversely, highly tumid. Second radials quadrangular, and from two to three times as wide as long. Third primary radials about one-half larger than the second, pentagonal, axillary, and bears upon each upper sloping side secondary radials. In four of the rays there are, upon each upper sloping side of the third primary radials, two secondary radials the last one being axillary and supporting upon each upper sloping side two tertiary radials, which gives to each of these rays four arms. In the ray on the left of the azygous area, there are, on the distal side of the third primary radial, two secondary radials, the last being axillary and supporting, on one side, a single tertiary radial, and upon the other two tertiary radials. The third primary radial bears on the proximal side two secondary radials, the last being axillary and bearing on the distal side two tertiary radials, and on the proximal side one tertiary radial which is axillary and bears on the distal side one quaternary radial which gives to this ray five arms. There are, therefore, in this species twenty-one arms.

There are two regular interradials in each area. The first one is large and tumid, the second one small. There are six plates in the azygous area. The first one is in line with the first primary radials, tumid and about as high as wide. It is followed by three tumid plates in the second range and by two smaller plates in the third range, that are cut off, by the tertiary and quaternary radials, from all connection with the vault.

The vault is elevated, convex, covered with tumid, polygonal plates, and bears a large, subcentral proboscis. The plate at the base of the proboscis opposite the azygous area is the largest plate connected with the vault.

This is the first species of *Batocrinus*, bearing twenty-one arms, that has been described, from the Burlington Group, and its arm formula, therefore, is sufficient to distinguish it from all other species. In form, it approaches *B. laetus* which has twenty-two arms, but may also be distinguished from it by the azygous area and other peculiarities.

Found by R. A. Blair, in the Burlington Group, at Sedalia, Missouri, and now in the collection of S. A. Miller.

BATOCRINUS BASILICUS, n. sp.

Plate 1, Fig. 10, azygous side; Fig. 11, opposite view; Fig. 12, summit view.

Body medium or below medium size and somewhat biturbinate, though the calyx is decidedly larger than the vault. Calyx truncated below and obconoidal above, though spreading most rapidly as the free arms are approached. About twice as wide as high. Arm openings directed horizontally. No radial ridges. Plates convex. Surface granular.

Basals very short and form a low hexagonal disc, with slight re-entering angles. The basal disc is about one-third wider than the diameter of the column and bears a shallow, radiately lined, concave depression for the attachment of the column. First radials a little wider than high, three hexagonal, two heptagonal, with the superior sides slightly arcuate. Second radials quadrangular, about half as wide as the first radials, but two or three times as wide as long. Third primary radials about the size of the second, pentagonal, axillary and bear upon each superior sloping side two secondary radials, the last one of which is axillary and bears upon each upper sloping side, in three of the rays, a single tertiary radial, which gives to each of these rays four arms. In each ray adjoining the azygous area there is, on the distal side of the distal second, secondary radial, an axillary tertiary radial, which bears upon each superior sloping side a single quaternary radial, and on the proximal side two tertiary radials; and on the distal side of the proximal second secondary radial, two tertiary radials, and on the proximal side a single axillary tertiary radial, which bears upon each upper sloping side a single quaternary radial, which arrangement gives to each of these rays six arms. There are, therefore, twenty-four arms in this species.

There are three plates in each regular interradial area, one followed by two small ones in the second range that do not connect with the vault. There are ten plates in the azygous area. The first one is in line with the first primary radials, and the largest plate in the body. It is followed by three plates in the second range, three smaller ones in the third range, two in the fourth range and one narrow, elongated plate in the fifth range, that separates the quaternary radials and unites with two plates that belong to the vault.

Vault convex, moderately depressed toward the interradial areas and strongly depressed toward the azygous area, and covered with numerous convex, polygonal plates. It bears a rather large, subcentral proboscis.

This is the only species of *Batocrinus* having twenty-four arms, from the Burlington Group, except *B. quasillus*, and it is so different, in general form and in the structure of the azygous and interradial areas from that species, that no comparison is necessary to distinguish it. It is quite unnecessary to compare it with any other species.

Found by R. A. Blair, in the Burlington Group, at Sedalia, Missouri, and now in the collection of S. A. Miller.

BATOCRINUS ASPERATUS, n. sp.

Plate I, Fig. 13, azygous view; Fig. 14, side view.

Body about medium size, laterniform or urn-shaped. Calyx broadly truncated below and slowly expanding above; about one-third wider than high. Arm openings directed upward at an angle of about thirty degrees. No radial ridges. Plates tumid and spiniform. Surface smooth or finely granular.

Basals short, forming an hexagonal disc, with re-entering angles, deeply notched at the sutures and projecting cuneiform edges below the end of the column and having a shallow concave depression for the attachment of the column. The basal disc is more than one-half wider than the diameter of the column. First radials a little wider than high, three hexagonal, two heptagonal, and each one bears a transverse cuneiform spine. Second radials quadrangular, two or three times as wide as long. Third radials larger than the second, pentagonal, axillary, and support on each upper sloping side two secondary radials, the last one being axillary and supporting on each upper sloping side a single tertiary radial, except on the proximal sides of the rays adjoining the azygous area, where there are two tertiary radials. There are, therefore, four arms to each ray, or twenty arms in this species. There is only one regular interradial in each area and it is spiniform. In the azygous area there are four spiniform plates. The first one is in line with the first primary radials, and it is followed by three plates, in the second range, that are cut off from the vault by the tertiary radials.

The vault is convex and covered with polygonal spiniform plates and bears a very small, central proboscis (?). Two plates appear to be broken out of the center of the summit of our specimen, and if they indicate a proboscis it was quite small, probably not elevated much above the summit of the vault.

This is a very peculiar species, having a shape somewhat like *Eretmocrinus konincki*, which is a *Batocrinus*, but distinguished from it by having twenty instead of eighteen arms, four instead of ten plates in the azygous area, by having the azygous area cut off from the vault instead of being connected with it, and by having a much smaller proboscis, more spiniform plates and other peculiarities.

Found by Mr. C. S. Hodgson, in the Burlington Group, in Adams county, Illinois, and now in the collection of S. A. Miller.

BATOCRINUS ASPER, n. sp.

Plate I, Fig. 15, basal view; Fig. 16, azygous side of calyx, part of one of the tertiary radials over the azygous area is broken away.

Species medium size. Calyx low, broadly truncated and rapidly expanded. Nearly three times as wide as high. Plates very tumid and radiately furrowed. Vault, proboscis and arms unknown.

Basals form a flat, hexagonal disc with strong, re-entering angles. It is on a level with the lower, flattened face of the first primary radials and bears a slightly concave, radiately lined facet for the attachment of the column, which is about equal to half the diameter of the disc. The columnar canal is of moderate size and cinquefoil. First primary radials a little wider than long, three hexagonal, two heptagonal, and sculptured pyramidal. Second primary radials quadrangular, about one-half wider than long and sculptured pyramidal. Third primary radials a little larger than the second, pentagonal, axillary, pyramidal, and bear upon each superior sloping side a single secondary radial, which is axillary and bears upon each upper sloping side a single tertiary radial, which gives to each ray four arm openings to the vault. There are, therefore, twenty arms in this species.

There are three regular interradials in each area, one pyramidal plate followed by two small ones that are cut off from the vault by the tertiary radials. There are four plates in the azygous area. The first one is in line with the first primary radials of the same size. It is followed by only two plates in the second range and one plate in the third range, which is cut off from the vault by the tertiary radials.

The sculpturing of this species is quite different from that of any other twenty armed species. The form, too, is different and so is the azygous area. It connot be mistaken for any other species.

Found by R. A. Blair in the Burlington Group. at Sedalia, Missouri, and now in the collection of S. A. Miller.

BATOCRINUS ADAMSENSIS, n. sp.

Plate I, Fig. 33, azygous side; Fig. 34, opposite view; Fig. 35, summit view.

Species below medium size. Calyx bowl-shaped, slightly pentagonal, which is most strongly marked when seen from above; less than one-half wider than high. Plates convex; sutures distinct. Radial ridges undefined, though interradial areas are somewhat flattened. Surface finely granular. Column medium size and pierced by a large, cinquefoil canal.

Basals form a low, hexagonal disc, which slightly expands upward and has a diameter full twice as great as the diameter of the column. The lower and outward sides of the basals are convex or rounded. The first primary radials are large and have a height nearly as great as the diameter, three hexagonal and two heptagonal. Second primary radials small, quadrangular, two or three times as wide as high. Third primary radials ahout twice as large as the second, pentagonal, axillary and support on each superior sloping side two secondary radials. There are, therefore, ten arms in this species.

All of the interradial areas connect with the plates belonging to the vault. In the regular interradial areas the first plate is followed by two elongated plates in the second range, which unite with one or two plates which separate the arms and unite with the plates of the vault. In the type specimen, two plates may be distinguished in the third range, in three of the areas, but in the other area only one can be distinguished, though possibly there are two also. The first plate in the azygous area is the largest plate in the body. It is longer than a first primary radial and in line with them. It is followed by three plates in the second range, two quite small plates in the third range and three plates in the fourth range that separate the arms and unite with four plates belonging to the vault.

The vault is only moderately convex and terminates in a large subcentral proboscis, that is broken away from our specimen. The vault is covered with numerous, slightly convex, polygonal plates.

This is the first ten armed species of *Batocrinus* described from the Burlington Group, and is so far removed from all others that no comparison with any of them is necessary.

Found by C. S. Hodgson in the Burlington Group, in Adams County, Illinois, and now in the collection of S. A. Miller.

BATOCRINUS FOLLICULUS, n. sp.

Plate I, Fig. 36, azygous view; Fig. 37, opposite side; Fig. 38, summit view.

Species medium or below medium size and ovoid in outline. Calyx broadly rounded below and contracted above the third radials so as to make it somewhat globular. The length is about equal to the diameter at the bases of the arms, but the greatest diameter is below, in the region of the third primary radials. Plates convex and sutures distinct. No radial ridges. Surface finely granular. Column small.

Basals form a very low hexagonal disc, which expands upward and is concave below for the reception of a small column The basals are so short that they hardly interrupt the general globular form of the calyx below. First primary radials rapidly expand and with the radials form a low saucer-shaped cup. Their length is nearly equal to their breadth, three hexagonal and two heptagonal. Second primary radials, quadrangular, and from one-half wider to twice as wide as long. Third primary radials very little if any larger than the second, pentagonal, axillary, and support on each superior sloping side two secondary radials. There are, therefore, ten arms in this species.

The first regular interradials are large, convex plates. There are two plates in the second range, one of which is elongated and in some of the areas appears to connect with a plate belonging to the vault, and, in other areas, the last secondary radials appear to unite and cut off the interradial area. The first azygous plate is in line with the first primary radials, and though longer is somewhat smaller than either of them. It is followed by two large, nearly equal plates, in the second range, one in the third range, and one narrow, elongated plate in the fourth range that unites with the plates of the vault.

The vault is conoidal and terminates in a large subcentral proboscis, which is broken off in our specimen, as shown in the illustration. The vault is covered with a few large, convex plates.

It is unnecessary to compare this species with *B. adamsensis*, above described, and it is so different from all other *Batocrinus* that no comparison with any of them will show any near affinity to it. It is a well marked and peculiar species.

Found by R. A. Blair, in the Burlington Group, at Sedalia, Missouri, and now in the collection of S. A. Miller.

BATOCRINUS MODULUS, n. sp.

Plate I, Fig. 39, basal view; Fig. 40, azygous side; Fig. 41, summit view.

Species small. Calyx broadly rounded below, hemispherical, nearly two and a half times as wide as high. No radial ridges or convex plates. Arm openings directed upward at an angle of ten or twenty degrees. Surface granular.

Basals substantially covered by the end of the column, and bear a moderately concave depression for the attachment of the column, which is also supported by a little rim around the outside of the concavity. First primary radials nearly as long as wide, three hexagonal, two heptagonal. Second primary radials quadrangular, three or four times as wide as long Third primary radials about one-half larger than the second, pentagonal, axillary, and in the ray opposite the azygous area bears upon each upper sloping side two secondary radials, which gives to this ray two arms. In one of the lateral rays the third primary radial supports upon each superior lateral side a single secondary radial which is axillary and supports on each upper sloping side a single tertiary radial, which gives to this ray four arms. In each ray adjoining the azygous area the third primary radial bears upon the distal side two secondary radials and on the proximal side one secondary radial which is axillary and bears upon each superior sloping side a single tertiary radial, which gives to each of these rays three arms. The other lateral ray is constructed, in like manner, and bears three arms. There are, therefore, fifteen arms in the species.

There are two regular interradials in each area, one following the other and cut off from the vault by the union of the secondary and tertiary radials. In the azygous area there are four plates. The first is in line with the first primary radials and of about the same size. It is followed by three plates in the second range, the middle one of which is large and elongated and extends to the plates of the vault.

The vault is highly convex, covered with polygonal plates and bears a very small, subcentral proboscis, which is broken off at the top of the vault in our specimen.

This species is quite peculiar in its form and structure and the first species ever described, from the Burlington Group, which possessed fifteen arms.

Found by Mr. C. S. Hodgson, in the Burlington Group, in Adams county, Illinois, and now in the collection of S. A. Miller.

BATOCRINUS NANUS, n. sp.

Plate I, Fig. 42, azygous view; Fig. 43, opposite side; Fig. 44, summit view.

Species small, below medium size, biturbinate, calyx larger than the vault. Calyx obconoidal, somewhat pentagonal, in the superior part, by reason of a flattening or slight depression of the interradial areas; about one-half wider than high. Radial ridges undefined. Plates slightly convex; surface finely granular.

Basals form a low hexagonal disc, but are so injured in our specimen that a particular definition cannot be given of them. First primary radials large, nearly as long as wide, three hexagonal, two heptagonal. Second primary radials small, from one-half wider to twice as wide as long, quadrangular. Third primary radials about one-half larger than the second, pentagonal, axillary, and support on each superior sloping side a single secondary radial. There are, therefore, ten arms in this species.

All of the interradial areas connect with plates belonging to the vault. In the regular interradial areas the first plate is followed by two plates, in the second range, which unite with two plates, about on a level with the top of the secondary radials. The last two plates cover part of the ambulacral canals and, therefore, properly belong to the vault. The first plate, in the azygous area, is longer than a first primary radial, and nearly as large and in line with them. It is followed by three plates in the second range, which are subequal, in size. These are followed by two plates in the third range that unite with three plates belonging to the vault.

The vault is obconoidal and is produced in a large subcentral proboscis. It is covered with numerous, convex, polygonal plates.

This species most resembles *B. adamsensis* and seems to have no near affinity with any other described species. The two species, however, may be readily distinguished by the general form, for this species is much more elongate and biturbinate, in outline, than that species. There is only one secondary radial in this species, and there are two in that. The plates in the azygous areas are quite different, and there is one more range, having three plates, in that species, than there is in this.

Found in the Burlington Group, by R. A. Blair, at Sedalia, Missouri, and now in the collection of S. A. Miller.

BATOCRINUS CISTULA, n. sp.

Plate I, Fig. 24, azygous view, a little compressed on one side; Fig. 25, basal view; Fig. 26, summit view.

This species is medium size. Calyx bowl-shaped, moderately truncated below and rounding and spreading to the arms; about twice as wide as high. Plates moderately convex and beveled toward the sutures. Ambulacral openings directed upward at an angle of ten to twenty degrees. No radial ridges.

The basals form an hexagonal disc that bears a rounded rim or band around the end of the column. The disc bears a concave, radiately furrowed depression for the attachment of the column. First primary radials large, from one half wider to twice as wide as long, three hexagonal, two heptagonal. Second primary radials, about half as large as the first, quadrangular, from two and a half to three times as wide as long. Third primary radials about as large or smaller than the second primary radials, two hexagonal, three pentagonal, axillary, and in four of the rays support upon each superior sloping side two secondary radials, the last being axillary and bearing upon each upper sloping side two secondary radials. In some of the rays there are three secondary radials, which gives to each of these rays four arms. In the ray opposite the azygous area the third primary radial bears upon each upper side three secondary radials, which gives to this ray two arms. There are, therefore, eighteen arms in this species and eighteen arm openings to the vault.

There are three plates in each regular interradial area, one large plate followed by two small ones, that are cut off from any connection with the vault. The azygous area contains eight plates. The first one is in line with the first primary radials and fully as large. It is followed by three large plates, subequal in size, in the second range, and these by three small plates, in the third range, that are surmounted by a single plate in the fourth range that unites with two plates belonging to the vault.

The vault is somewhat elevated over the ambulacral openings, and convex toward the center, which bears a proboscis, that is broken off in our specimen just above the summit. It is covered with numerous, convex, polygonal plates, some of which bear central nodes. We are unable to discover any ovarian pores. It is probable, that, in some species, the ovarian pores were on the sides of the arms near the calyx, if the pores are correctly named. We know, that in some genera, as in *Dolatocrinus*, they vary in their places of exit from interradially on the vault to the base of the arms, and we see no reason why the channels may not have been carried up the ambulacral furrows one or more plates beyond the commencement of the free arms.

This species is distinguished by its general form, by having only eighteen arms, three regular interradials cut off from the vault and eight azygous plates, the last one connecting with the vault. These peculiarities do not exist in any other described species. It is probably as closely related to *B. labellum*, from the Keokuk Group, as to any other species, though a glance will distinguish them on account of the general form and surface of the plates, beside the interradial areas are not alike, and, in that species, the azygous area is cut off from the vault, and in this species it is connected with the vault.

Found by Dr. M. N. Elrod in the St. Louis Group, at Lanesville, Indiana, and now in the collection of Wm. F. E. Gurley.

BATOCRINUS JESSIEÆ, n. sp.

Plate I, Fig. 27, azygous view of a specimen with basals and part of first radials broken off; Fig. 28, summit of same; Fig. 29, basal view of same specimen; Fig. 30, lower part of the calyx of what is believed to be another specimen; Fig. 31, azygous view of what is supposed to be a cast of the same species; Fig. 32, basal view of the cast.

Species medium size. Calyx somewhat bell-shaped, truncated below, cylindrical, in the region of the first primary radials, and then rapidly expands to the free arms and is deeply notched in the interradial areas. The secondary radials project horizontally beyond the interradial areas. The plates are plain and smooth. Column round and small. Columnar canal minute.

The basals are about twice as wide as high and form a low cup slightly beveled at the basal sutures and having a small basal rim. It bears an hemispherical depression, radiately lined, for the insertion of the column. The diameter of the column is about half the diameter of the basal disc. The first radials are about as long as wide, three hexagonal and two heptagonal. They stand nearly vertical on the basals and form a round cylinder. Second radials comparatively very small, quadrangular, from one-half wider to twice as wide as high. Third primary radials of unequal size, larger than the second primary radials, three heptagonal, one hexagonal, one pentagonal, axillary and each bears on each superior sloping side two secondary radials. Each second secondary radial, in four of the rays, is channeled by two ambulacral furrows, which gives four ambulacral openings to the vault, in each of these rays, without the existence, apparently at least, not only as shown by the specimen preserving the plates but by the cast also, of any tertiary radials. In the ray opposite the azygous area there are also two secondary radials (only one is shown in the illustration, because the other is broken off from the specimen). but there are only two ambulacral openings to the vault. There are, therefore, eighteen ambulacral openings to the vault in this species.

All of the interradial areas connect with the vault. In each regular interradial area there are five plates. One of moderate size in the first range, two small ones in the second range and two elongated plates in the third range that curve over between the secondary radial plates and connect with the plates of the vault. There are eight or more plates in the azygous area. The first one is in line with the first primary radials and of about the same size. It is followed by a range of three plates and above the plate on the left there is a small intercalated plate, and, above these, there are three plates that connect with the plates of the vault. In fact, they interlock with the plates of the vault so that there is no distinct line between the plates of the calyx and those belonging to the vault. There is also a minute plate intercalated above the second range on the right, as shown on the specimen preserving the plates, but it is not indicated on the cast. There is a little difference, in the upper part of the azygous areas, between the cast and the specimen having the plates, and the cast indicates nine plates in the area; but, on the whole, we think the cast belongs to this species.

The vault is convex and is covered with convex polygonal plates and bears a central proboscis that is broken off from our specimens. The cast shows the ambulacral channels are flattened on the superior side, but have a depth equal to the flattened diameter. The ambulacral openings are within the margin of the stellate projections of the radials and appear to be directed upward, notwithstanding that the lower side of the radials is projected horizontally, and the cast shows the ambulacral openings to be directed horizontally.

This is a very distinct and peculiar species that can hardly be compared with any other. It would seem to be as near *B. astericus* as to any other species, though that species has twenty arms, rounded basals, and altogether different regular areas and azygous area.

Found by R. A. Blair, in the Burlington Group, at Sedalia, Missouri, and now in the collection of S. A. Miller. The specific name is intended as a compliment to the accomplished daughter of R. A. Blair, who has assisted her father so much in collecting and making known the fauna of the Chouteau and Burlington Groups of Missouri.

imal side two tertiary radials, which gives to each of these rays three arms. There are, therefore, in this species twelve arms. The last tertiary and secondary radial, in each series, is highly convex and the convexity extends below that of the secondary radial and third primary radial below it, which leaves a circular depression between the first primary radials and the last secondary and tertiary radials. The margin of the calyx thus seems to hang down and the ambulacral openings are exposed, in a basal view, while they cannot be seen in a summit view.

There are three plates in each regular interradial area, the first one rests between the superior sloping sides of the first primary radials and extends up between the first secondary radials. It is followed by two narrow elongated plates that connect with two plates belonging to the vault. The first azygous plate is in line with the first primary radials, nearly as large and heptagonal. It is followed by three plates in the second range, the middle one being the larger and extending to a plate belonging to the vault. On each side of the superior end of this middle plate there is an elongated narrow plate abutting the first tertiary radial and extending to the plates of the vault. There are, therefore, six plates in the azygous area belonging to the calyx.

The vault is only moderately convex, and is covered with large, polygonal, tumid plates that hang over the margin so as to hide the ambulacral openings from a summit view. At the margin of the azygous area there is an elliptical, bulbous prominence that shows no indication of having an orifice, from an azygous side view; but on the top of it there is a small opening partly surrounded by small plates. The orifice is irregular and an examination of it leads to the inference that it was covered by small plates. Indeed, there can be little doubt about it; and, if the orifice was not closed, by small plates, it was minute and not the kind one would expect to find in such a robust species.

This is a strongly marked species, so different, in all aspects, from those hitherto described, that no comparison will aid in distinguishing it.

Found by C. S. Hodgson, in whose honor we have proposed the specific name, in the Burlington Group, in Adams county, Illinois, and now in the collection of S. A. Miller,

AGARICOCRINUS ILLINOISENSIS, n. sp.

Plate I, Fig. 21, basal view: Fig. 22, summit view; Fig. 23, azygous side view.

Species medium or rather below medium size. Calyx very low, moderately concave in the region of the basals and first primary radials, then gradually rounds over on the radial series, which are produced nearly on a level, while the plates curve up in the interradial areas. The concavity at the place of attachment of the column is about on a level with the dorsal side of the last secondary radials. The outline of the calyx is pentagonal with slightly concave sides for the depressed interradial areas. Plates thick, smooth or granular. Ambulacral openings elongated, directed upward and not visible in a basal view. Column medium size.

Basals form an hexagonal disc that is nearly or quite covered by the column. The first primary radials are elongated, transversely concave to correspond with the basal concavity, three hexagonal and two heptagonal. Second radials much smaller than the first, quadrangular, and from one-half wider to twice as wide as long. Third primary radials shorter and wider than the second, pentagonal, axillary, and support on each upper sloping side three secondary radials, the last one of which commences the double series of arm plates, but the inner half connects with a plate belonging to the vault that separates the ambulacral canals, and, therefore, does not belong to the free arms. There are only ten arms in this species, and ten arm openings to the vault. The arms evidently consist of the usual double series of plates united by a zigzag suture.

There is one regular interradial in each area. It is elongated and has nine sides. It rests between the short superior lateral sides of the first primary radials, separates the primary and secondary radials and connects its superior, narrow elongation, by a short truncated end, with a plate belonging to the vault, midway between the arms, at the top of the calyx. The first azygous plate is in line with the first primary radials and of the same general form, though longer and narrower, and of course heptagonal. It is followed by three plates, in the second range, the lateral ones are short and heptagonal, the middle one is elongated, hexagonal and unites its superior truncated end, with a plate belonging to the vault, midway between the arms, at the top of the calyx. The vault is low, most convex centrally, and the pentagonal outline, at the margin, becomes obsolete toward the center. The capacity of the vault is less than that of the shallow calyx. The vault bears a rather large, convex, central plate and is otherwise covered with small and less convex polygonal plates., The large tumid plates that usually extend from the arms to the summit in this genus, do not characterize this species. The azygous orifice is not elevated or situated on a tumid swelling, as is usual in this genus, but is surrounded by small plates and a short side of the large central plate.

The depressed, short body, pentagonal outline of the calyx, small plates of the vault, single interradials, four azygous plates and ten arms are features that distinguish this species from all others. There is no described species, from the Burlington Group, with which it can be said to have much resemblance, but in its short body and general form it partakes of the character of *A. blairi*, from the Chouteau limestone, though the latter has only nine arms, is subquadrate in outline, and has more plates in the azygous and regular areas than this species has. It cannot be mistaken for any other described species.

Found by C. S. Hodgson, in the Burlington Group, in Adams county, Illinois, and now in the collection of S. A. Miller.

AMPHORACRINUS BLAIRI, n. sp.

Plate I, Fig. 45, basal view; Fig. 46, same magnified two diameters; Fig. 47, summit view; Fig. 48, same magnified two diameters; Fig. 49, azygous side; Fig, 50, same magnified two diameters. It will be observed that one of the rays adjoining the azygous area is injured, so it is not shown in the illustrations.

Species very small. Calyx broadly rounded below, bowl-shaped, or somewhat hemispherical. About twice as wide as high. Surface of test granular. No radial ridges.

Basals form an hexagonal disc one-half wider than the diameter of the column. First primary radials about as long as wide, three hexagonal, two heptagonal. Second primary radials smaller than the first, a little wider than long, hexagonal. Third primary radials somewhat smaller than the second, pentagonal, axillary and support on each upper sloping side a single secondary radial, which gives to each ray two arm openings to the vault, There are, therefore, ten arms in this species. The secondary radials are directed horizontally and stand out their full length from the interradial areas. The cast shows only a single secondary radial but the test preserves two before the arms are fairly free.

The first regular interradial is larger than a second primary radial, hexagonal, and followed by two somewhat smaller plates in the second range, and by two still smaller ones in the third range, that separate the first secondary radials and unite with the plates of the vault. The first azygous plate is in line with the first primary radials and quite as large. It is followed by three plates in the second range, four in the third range, and two in the fourth range, that unite with the plates of the vault.

The vault is quite evenly convex, covered with polygonal plates, and bears a submarginal azygous orifice.

There is no described species very closely resembling this one and, therefore, no comparison with any of them is necessary to distinguish it.

Found by R. A. Blair, in the Burlington Group, at Sedalia, Missouri, and now in the collection of S. A. Miller. The specific name is in honor of the collector. After the illustrations were drawn from a cast, we received a specimen preserving the plates, from F. A. Sampson, of Sedalia, but as the plates are small and not ornamented the illustrations are about the same as if drawn from the test itself.

MEGISTOCRINUS INDIANENSIS, n. sp.

Plate II, Fig. 1, basal view; Fig. 2, summit view; Fig. 3, azygous side view. Some of the sutures are obscure and are not shown in the illustrations.

Species large. We have a specimen one half larger than the one illustrated. The capacity of the vault in some specimens is greater than that of the calyx. Calyx broadly basin shaped, slightly concave about the basal plates, from two and a half to three times as wide as high, not constricted below the arms but continuing to expand as far as the free arms, which are directed nearly horizontally or upward at an angle of less than twenty degrees. Surface ornamentation of the plates not preserved in any of our specimens. Column moderate size and having a large, slightly cinque foil canal.

Basal plates form an hexagonal disc about one-fourth wider than the diameter of the column. The first primary radials are unequal in size; those abutting a single basal are hexagonal, and those abutting on two basals heptagonal. They are not visible in a side view. The second primary radials are as large as the first, hexagonal, and differ considerably in size. The third primary radials are also unequal in size, as large as the first or second, three heptagonal, two hexagonal, axillary, and, in the ray on each side of the azygous area and in the ray opposite the azygous area, bear on each upper sloping side a single secondary radial, which is axillary, and supports on each upper sloping side two tertiary radials, which gives to each of these rays four arms. In one of the lateral rays the third primary radial bears upon each upper sloping side three secondary radials, which gives to it two arms. In the other lateral ray, the third primary radial supports, on one superior sloping side, three secondary radials, and on the other a single secondary radial, which is axillary and supports on each upper sloping side two tertiary radials, which gives to it three arms. There are, therefore, seventeen arms and seventeen ambulacral openings to the vault in this species.

In each regular interradial area there are eight plates, the first one is hexagonal, rests between the upper sloping sides of the first primary radials, separates the second primary radials and is followed by two plates nearly as large in the second range, three in the third range and two in the fourth ronge, that separate the arms and unite with the plates of the vault. There is one plate in each of the intersecondary radial areas that connects with the vault, except in the two-armed lateral ray where the secondary radials unite. The azygous area is large and contains twenty-one plates. The first one is in line with the first primary radials and of the same size, it is followed by three somewhat smaller plates, in the second range, five plates, in the third range, five plates, in the fourth range, four plates, in the fifth range, and three plates, as near as can be determined, in the sixth range, that unite with the plates of the vault.

The vault is broadly convex over the central part and ambulacral channels and depressed toward the margin in the interradial areas. There is a small spine bearing plate in the center of the vault, and one over the junction of the ambulacral channels in each of the five radial series. The plates are small and the sutures too indistinct, over part of the vault of our specimens, to distinguish them. The azygous orifice is large, surrounded with numerous plates and subcentral. It was slightly elevated, but the summit is injured in all of our specimens. There are no ovarian pores shown, in any of our specimens.

This is the only species of *Megistocrinus* bearing seventeen arms so far as known, and, therefore, need not be compared with any other to distinguish it. It would seem to be most nearly related otherwise to *M. expansus*.

Found by Geo. K. Greene, in the Hamilton Group, near Charleston, Indiana, and now in the collection of Wm. F. E. Gurley.

STEGANOCRINUS SPERGENENSIS, n. sp.

Plate II, Fig. 4, azygous view; Fig. 5, opposite view; Fig. 6, basal view; Fig. 7, summit view.

Species medium or above medium size. Calyx obpyramidal, rather broadly truncated, pentagonal, and stelliform, as seen from above, in consequence of the horizontal, rigid extension of the five radial series. The abrupt, horizontal extension of the radial series commences at the top of the third primary radials, which commence curving outward from the calyx, while the interradial areas begin to curve gently in, toward the vault. Plates thick, very nodose and pyramidal. They are sculptured so as to depress the angles of the plates. Column large and round.

Basals form an hexagonal cup, more than twice as wide as high. Plates stand upright, and each extends a cuneiform end below the end of the column. Each plate is more than twice as wide as high and longitudinally furrowed on the surface, and the sutures are beveled. The first radials are the largest plates in the body, and each one is furrowed from the central node toward the angles and the basal plates below. A little longer than wide, three hexagonal, two heptagonal. Second primary radials less than half as large as the first, sculptured in like manner, wider than long, and hexagonal. Third primary radials a little smaller than the second, curve outward so as to sharpen the angles of the pentagonal calyx, heptagonal axillary, and support on each upper sloping side a single secondary radial which is axillary and supports on each upper sloping side the tertiary radials. The tertiary radials are preserved as far as the third plate, in our specimen, and to this extent and doubtless for several plates beyond they are consolidated in each series so as to leave no free arms. The two third radials in the middle of each series are axillary and bear quaternary radials. There are, therefore, thirty arms and thirty ambulacral openings to the vault in this species, as shown by our specimens.

The interradial areas all graduate up into the vault and over the ambulacral channels so as to leave no evidence of any dividing line between the vault and calyx. In the regular areas, one large plate is followed by two, in the second range, three, in the third range, and five, in the fourth range, that connect with the plates of the vault. In the azygous area the first plate is in line with the first primary radials and like them, except somewhat smaller. It is followed by two plates, in the second range, three, in the third range, five, in the fourth range, and eight, in the fifth range that connect with the plates of the vault. This area is very wide between the projecting radial series.

The vault is elevated over the ambulacral channels so that a transverse section of the radial series is subquadrate. It is convex toward the center where it bears a proboscis. It is covered with convex, polygonal plates of very unequal size. No ovarian pores have been detected.

This species is from rocks of a higher geological range than any heretofore described, but a true *Steganocrinus*, however, distantly related to other species.

Found by Dr. M. N. Elrod, in the St. Louis Group, at Spergen Hill, Indiana, and now in the collection of Wm. F. E. Gurley.

STROTOCRINUS ORNATUS, n. sp.

Plate II, Fig. 12, azygous view; Fig. 13, right lateral view; Fig. 14, summit view.

Species rather below medinm size, as shown by our specimens. Calyx moderately truncated below, obconoidal as high as the top of the third primary radials, and then abruptly expanded, in the form of a flattened rim, that cuts off all connection of the interradial areas with the vault, as is usual in this genus. Primary radials transvesly nodose, interradials nodose, and surface of all of them radiately sculptured; above the primary radials, the radial ridges are somewhat angular at first but rounded above.

Basals wider than high, stand upright, deeply beveled at the sutures and each extends a cuneiform end below the point of the columnar attachment. First primary radials about as long as wide, three hexagonal, two heptagonal. Second primary radials about two-thirds the size of the first, hexagonal, and nearly as long as wide. Third primary radials almost as large as the second, hexagonal, axillary, and support on each upper sloping side a single secondary radial, which is axillary, and, in two of the rays, one of which adjoins the azygous area, and the other a lateral ray on the same side, bears upon each proximal side a single tertiary radial and upon each distal side two tertiary radials, which gives to each of these rays four arms. In the other three rays the distal side of each secondary radial bears two tertiary radials and the proximal side bears a single tertiary radial which is axillary and bears upon each superior sloping side a quaternary radial, which gives to each of these rays six arms. There are, therefore, twenty-six arms in this species.

There are, in each of four of the regular interradial areas, seven plates, one in the first range, two in the second, two in the third, and two in the fourth. In the other area there are eight plates. The last four plates are very small. In the azygous area there are eleven plates. The first one is in line with the first primary radials and about the same size. It is followed by two plates, in the second range, three, in the third, three, in the fourth, and above these, there are two very small plates. The three plates, in the fourth range, are much smaller than those in the third range. There are no inter-secondary plates.

Vault moderately convex, composed of numerous convex, polygonal plates, and bears a small nearly central proboscis.

In describing this genus Meek & Worthen (5 Ill., 347,) included as typical *S. perumbrosus* and *S. liratus* and showed that they had the structure of *Actinocrinus*, "Up to the division of the rays, but with the body comparatively long and narrow below, and the secondary and other succeeding supplementary radials, brachial and intermediate pieces, connected laterally all around, and spreading out horizontally far beyond the limits of the body so as to form, with the flat or much depressed vault, a broad, more or less distinctly ten-angled disc, from the margins of which the numerous long, slender arms arise, without bifurcating after becoming free." It will be seen that this arrangement cuts off the interradial areas from the vault and presents a structure of the calyx above the third radials fundamentally different from that of *Actinocrinus*. They said further that:

"Some of the species, such as *S. perumbrosus*, have but a very small simple opening situated subcentrally, or more or less excentrically toward the anal side, and penetrating the flattened vault obliquely, so as to be directed forward or away from the anal side; while others, like *S. liratus*, have a long erect, subcentral tube, or so-called proboscis, sometimes recurved at the end."

Wachsmuth & Springer proposed to divide this genus and make *S. liratus* the type of a new genus which they called *Teleiocrinus*, which differs from *S. perumbrosus*, in no other respect, than that pointed out above by Meek & Worthen. In other words the genus *Teleiocrinus* is to be distingnished from *Strotocrinus*, upon the elevation of the azygous opening. If the opening is at the top of the vault it is *Strotocrinus*, but if it is elevated the height of a plate it is *Teleiccrinus*; and so if it is elevated one-fourth of an inch or half an inch, or an inch or more it is still *Teleiocrinus*. This method of nomenclature we do not approve. We have shown, elsewhere, that the presence or absence or form of a proboscis, in *Batocrinus*, is not of generic importance and the same is true throughout the *Actinocrinidæ*. The genera must be distinguished by the calyx. Therefore, after having given the subject our best consideration, we conclude that *Teleiocrinus* must be regarded as a synonym for *Strotocrinus*.

The species here under consideration is a *Strotocrinus*, as the genus was defined by Meek & Worthen, and the simple fact that it has a small proboscis will not take it out of that genus. It is the only species thus far defined having twenty-six arms and will be readily distinguished from all others by the arm formula and interradial areas.

Found in the Burlington Group, near Burlington, Iowa, and now in the collection of S. A. Miller.

ACTINOCRINUS JESSIEÆ, n. sp.

Plate II, Fig. 15, azygous side; Fig. 16, opposite view.

Species large. Calyx obconoidal, regularly expanding from the column, about one-fourth wider than high. Surface beautifully sculptured so as to make each plate more or less obpyramidal from a central node. No radial ridges. Column not large.

Basals form an expanding cup, they project a little below the point of columnar attachment with the margins notched so as to form a trilobed base, which is concave for the attachment of the column, and the top is one-half wider than the diameter at the base. The plates are about twice as wide as high, and the sutures are broadly beveled. A delicate angular ridge extends from the bottom of each plate to the middle of each side of the adjoing radials. First primary radials the largest plates in the calyx, a little wider than long, three hexagonal, two heptagonal. The central node is high, transverse, and from it a delicate angular ridge radiates to the middle of each side of each adjoining plate. When viewed from below these high, transverse nodes obscure the view of the plates above. Second primary radials about half as large as the first and ornamented in the same way. The one on the left of the azygous area is pentagonal, the others are hexagonal. The third primary radials are smaller than the second and ornamented in the same way. Three are hexagonal, one heptagonal and one pentagnal. The heptagonal plate and one of the hexagonal plates are truncated, at the summit, by an inter-secondary plate. In the other areas the inter-secondary plates do not abut upon the third primary radials. They are axillary and support on each superir lateral side a single secondary radial, which is ornamented like the radials below, and is axillary and supports on each upper sloping side a single tertiary radial. The tertiary radials are also ornamented like the radials. This is a feature common to every plate in the calyx, except the nodes become more pointed and less transversely elongated as they approach the free arms. There are, therefore, twenty arms and twenty ambulacral openings to the vault in this species.

All the interradial and intersecondary areas connect their plates with the plates of the vault. In the intersecondary areas there are two narrow plates, one following the other, the last one extending to the vault. The number of regular interradials varies in the different areas from five to seven. In an area having five plates there is one plate in the first range, two in the second, one in the third and one in the fourth. In another area having six plates, there are two plates in the third range, and in an area having seven plates, there are two plates in the third range and two in the fourth range. In the azygous area there are nine plates. The first one is in line with the first primary radials and about as large. It is followed by two plates in the second range, two in the third range, then one small sunken square plate and one nodose plate, and above these two plates that unite with the plates of the vault.

This species is distinguished by its general form and surface ornamentation from all other described species. It is again distinguished by having all the interradial and intersecondary radials connected with the vault, and bearing twenty arms. A basal view will distinguish it from all other species.

Found in the Burlington Group, at Sedalia, Missouri, by Miss Jessie Blair, an accomplished scholar and student of Geology, for whom we have proposed the specific name.

FAMILY POTERIOCRINIDÆ.

ZEACRINUS PECULIARIS, n. sp.

Plate II, Fig. 17, azygous area on the left, specimen compressed; Fig. 18, opposite side of the same compressed specimen; Fig. 19, basal view of same.

Species rather above medium size, and when not compressed elongate-elliptical in outline. Calyx very low. Columnar cavity rather deep. Surface finely granular. Column small, round and having a minute columnar canal.

Basal plates within the calyx, the hollow conical cavity being filled with the end of the column. Subradials have rather acute superior angles but they are not visible in a lateral view. First radials only a little wider than long, the inferior angles extend into the columnar cavity, the plates expand to the superior lateral angles and are truncated the entire width above for the support of the second primary radials. Three are pentagonal, and the two adjoining the azygous area are hexagonal. They are separated from the second primary radials externally by slightly gaping sutures. The second primary radials are a little shorter than the first, but wider as they continue the same rate of expansion possessed by the first as far as the superior lateral angles. Three are pentagonal, the one on the left of the azygous area hexagonal, and these four are axillary and support on each superior sloping side the secondary radials; but in the ray opposite the azygous area there are three primary radials, consequently the second one is quadrangular. It is about two and a half times as wide as long. The third one is smaller than the second, pentagonal, axillary and supports on the upper sloping sides secondary radials. In the ray on the right of the azygous area there are three secondary radials in the proximal series and four in the distal series. Each lateral ray is constructed in the same way. In the ray on the left of the azygous area, there are three secondary radials, in the proximal series, and five in the distal series. In the ray opposite the azygous area there are four secondary radials in each series. The last secondary radial, in each series, is axillary. The proximal tertiary rays do not bifurcate. They are composed of subquadrate plates, thirty of which are preserved, in some of the rays, in our specimen, before they are broken off. The distal tertiary rays bifurcate, in four instances, on the sixth plate and in the other six rays on the fifth plate. This arrangement gives to each ray six arms, or thirty arms in the species.

In the azygous area there are five plates, the first truncates a subradial diagonally, separates the first primary radials and supports two plates above. The second truncates an angle of a first primary radial, instead of a subradial, as is usual in this genus. It is hexagonal, abuts the second and third primary radials on the left, the third azygous plate on the right and supports the fourth azygous plate. The third is smaller and abuts upon the first, second and third primary radials on the right. The fourth is the largest in the area and extends to the third secondary radials. The fifth presents a triangular face with the superior angle as high as the summit of the first tertiary radials.

This species is distinguished by the shape of the body, number of secondary radials, thirty arms, and peculiar azygous area. It cannot be mistaken for any other species.

Found by Prof. A. G. Wetherby, in the Kaskaskia Group, in Pulaski county, Kentucky, and now in the collection of Wm. F. E. Gurley.

ZEACRINUS DOVERENSIS, n. sp.

Plate II, Fig. 20; azygous side view; Fig. 21, opposite view; Fig. 22, basal view. The specimen is slightly compressed laterally.

Species medium size and elongate-elliptical in outline. Calyx truncated below. Surface granular. Column small, round, and having a minute central canal.

Basal plates within the calyx, the hollow conical cavity being filled with the end of the column. Subradials have an acute superior angle visible in a lateral view. First radials nearly twice as wide as long, the lateral sides expand to the superior lateral angles, truncated the entire width above for the support of the second primary radials, from which they are separated externally by a slightly gaping suture. All are pentagonal. The second primary radials in four of the rays are shorter than the first, pentagonal, axillary, and support on the superior sloping sides the secondary radials. In the ray opposite the azygous area there are four primary radials, the second and third are quadrangular, but the third is only about half as large as the second, and the fourth is short, pentagonal, axillary and supports the secondary radials. In the proximal ray on the left of the azygous area and in one of the lateral rays on the same side there are three secondary radials, in the other eight rays there are four secondary radials. The last secondary radials are pentagonal, axillary, and support the tertiary radials. There are only four tertiary radials preserved in any of the rays in our specimen, and hence our specimen shows only twenty arms in the species. Possibly, the distal series in each ray may divide.

There are seven plates in the azygous area. The first one is pentagonal, rests between the superior sloping sides of two subradials and below the first primary radial on the right. The second truncates a subradial and is heptagonal. The third is heptagonal and abuts the two primary radials and one secondary radial on the right. The fourth is quadrangular, small, and rests on the second. The fifth is the largest plate in the area and rests between the superior lateral sides of the third and fourth plates. The sixth is smaller and rests on the fifth.

The seventh is a small, triangular plate at the top of the area, between the tertiary primary radials.

This species is distinguished by the general form, number of primary radials, in the ray opposite the azygous area, number of secondary radials, in the different areas, and by the number of plates in the azygous area. These characters will distinguish the species from all others.

Found by Dr. M. N. Elrod in the Kaskaskia Group, at Dover Hill, Indiana, and now in the collection of Wm. F. E. Gurley.

ZEACRINUS KENTUCKIENSIS, n. sp.

Plate II, Fig. 23, basal view, showing the inferior part of the azygous area; Fig. 24, view opposite the azygous area, the specimen is a little compressed.

Species rather above medium size and when not compressed elongate-elliptical in outline. Calyx very low and columnar cavity deep. Surface finely granular. Column small and round.

Basal plates within the calyx, the hollow conical cavity being filled with the end of the column. Subradials have acute superior angles, but they are not visible in a side view, though they curve up out of the columnar cavity. First radials about one-half wider than long and form a rounded base upon which a specimen may be made to stand. The inferior angles extend slightly into the columnar cavity, the plates expand to the superior lateral angles and are truncated the entire width above for the support of the second primary radials, from which they are separated, externally, by a wide gaping suture. Each one of them is pentagonal. The second primary radials are much shorter than the first, four of them are pentagonal, axillary, and support on each superior sloping side the secondary radials; but in the ray opposite the azygous area there are three primary radials; the second one is short and quadrangular, and the third one is smaller than the second, pentagonal, axillary, and supports on each upper sloping side secondary radials. In one of the rays, on the left of the azygous area, and in one of the lateral rays, on the right of the azygous area, there are four secondary radials, and in each of the other eight series there are only three secondary radials. In the ray opposite the azygous area the proximal tertiary rays do not bifurcate, but the distal rays divide on the fourth plate, which gives to this ray six arms. In the ray on the left of the last one described, as may be seen in the illustration, the distal tertiary series bifurcate on the fourth plate and the distal ones, in the quaternary series, bifurcate on the fifth plate, which arrangement gives to this ray eight arms. The ray on the right of the azygous area is constructed like the last one described and bears eight arms. The other two rays are injured in the superior part, but as far as preserved, they are like the two last described. There is little doubt, therefore, that the species bears thirty-eight arms.

There are six plates in the azygous area. The first is elongated, pentagonal, rests between the superior sloping sides of two subradials and the inferior sloping side of the first primary radial on the right. The second truncates a subradial adjoins the two primary radials on the left, and the first and third on the right and supports the fourth above. It is a small hexagonal plate. The third is heptagonal and about the size of the second. The fourth and fifth plates rest on the second and third and are about the same size. The sixth plate is the largest plate in the area, triangular, and extends its superior angle to the lower side of the third tertiary radials.

This species is distinguished by its general form, by the number and structure of its thirty eight arms and by the six plates in the azygous area.

Found by Prof. A. G. Wetherby, in the Kaskaskia Group, in Pulaski county, Kentucky, and now in the collection of Wm. F. E. Gurley.

BARYCRINUS ELRODI, n. sp.

Plate II, Fig. 25, azygous view; Fig. 26, basal view; Fig. 27, view opposite the azygous area.

Species large and plates remarkably thick. Calyx rapidly expanded, broadly bowl-shaped, one-half wider than high. Plates very tumid and radiately sculptured so as to leave an angular ridge directed to the middle of the side of each abutting plate.

Basals form a low expanding cup. The column is large and covers the bottom of the basal cup. The columnar canal is very large and pentalobate. A furrow arises at the summit of each first primary radial and descending slowly widens and deepens to the lower surface of the basal cup. Subradials large nearly as long as wide, radiately furrowed toward each angle and toward the middle of the basal plates, so as to leave two angular ridges extending to the basal plate below and one to the middle of each side of the adjacent plates. First radial the largest plates in the calyx, wider than high. Two rounded ridges arise at the lower edge of the facet for the second radials on each plate and extend to the middle of the adjacent sides of the subradials. The plates are arcuately depressed laterally so as to leave the lateral sutures at the bottom of the furrow or concavity. There is a broad, concave facet, extending nearly the entire width of each plate and depressed outwardly, at an angle of about forty degrees below a horizontal line, for the second radials. The superior lateral sides come together, at the sutures, so as to form a slight angle.

The first azygous plate broadly truncates a subradial. It is subquadrate in outline, but slightly expands upward. It is a little wider than high.

The general form, low basals, single azygous plate, thick plates and surface ornamentation readily distinguish this species from all others.

Found by Dr. M. N. Elrod, in whose honor the specific name is given, in the St. Louis Group, at Spergen Hill, Indiana, and now in the collection of Wm. F. E. Gurley.

POTERIOCRINUS PULASKIENSIS, n. sp.

Plate III, Fig. 26, azygous side; Fig. 27, opposite side, showing two plates, in two of the arms, above the first radials.

Species medium size. Calyx broadly truncated, and conoidal above or like the frustum of a cone. Plates convex and sutures depressed, at the angles, and a pore penetrates the calyx, at every angle. in the same manner that they do in *P. broadheadi*; though then do not seem to be any pores between the angles as in that species. Diameter a little more than the height.

Basals short and truncated by the column. Subradials large and about as long as wide, three hexagonal, two heptagonal. First radials about one-fourth wider than long, truncated the entire width above and separated from the second plates by a gaping suture. Second radials short. Third radials in the two rays opposite the azygous area short and axillary. Indicating that there are ten arms in this species.

The first azygous plate is nearly as large as a subradial, rests between the superior sloping sides of two subradials, separates two first radials and supports the second and third azygous plates which makes the plate hexagonal, though only slightly truncated by the third azygous plate. The second azygous plate is only a little more than half as large as the first. The third plate is not preserved in our specimen.

This is an extraordinary species that does not require a comparison with any other for the purpose of distinguishing it.

Found by Prof. A. G. Wetherby, in the Kaskaskia Group, in Pulaski, county, Kentucky, and now in the collection of Wm. F. E. Gurley.

FAMILY DOLATOCRINIDÆ.

DOLATOCRINUS INDIANENSIS, n, sp.

Plate III, Fig. 1, basal view; Fig. 2, summit view, azygous side on the left; Fig. 3, azygous side view.

Species large. Calyx subhemispherical, very broadly truncated and slightly concave on the lower side, and constricted below the arms. Very small radial ridges. Central nodes small on the radial ridges and inconspicuous or obsolete on the other plates. Radiating lines from the central part of each plate numerous, but small. Column round and having a large cinquefoil columnar canal that occupies more than half its diameter.

Basal plates form a pentagonal disc a little depressed below the central part of the surrounding radials and having a diameter about one third more than the diameter of the column. First primary radials from one-third to one-half wider than long and subequal in size. Second primary radials nearly twice as wide as long, quadrangular. Third primary radials expand slightly to the superior lateral angles. They are nearly twice as wide as long, pentagonal, axillary, and in the rays on each side of the azygous area and in the ray opposite the azygous area bear upon each superior sloping side a single secondary radial, which is axillary and bears upon each upper sloping side a single tertiary radial, which gives to each of these rays four arms. In one of the lateral rays the third primary radial bears upon one superior sloping side two secondary radials and upon the other a single secondary radial, which is axillary and bears upon each upper sloping side a single tertiary radial. This ray, therefore, has three arms. In the other lateral ray the third primary radial bears upon each upper sloping side two secondary radials that give to it two arms. There are, therefore, in this species seventeen arms, and seventeen ambulacral openings to the vault, all of which are directed upward.

The azygous area is like the other areas or so near like them that it is hard to distinguish any difference. The first interradials are the largest plates in the calyx, have nine sides, and are broadly truncated above for the second interradials. The second interradials are about, or less than, half as large as the first, and are followed by a single plate less than half as large as the second, and which unites with two elongated plates belonging to the vault.

The vault is slightly convex toward the central part and equally as much depressed in the interradial areas toward the margin. The plates are large, but the sutures are too indistinct, in our specimen, to allow the artist to trace them, besides, the surface is so eroded as not to preserve the surface ornamentation. The subcentral azygous orifice is excentric from the azygous side, which is well shown in figure 2 and presents a peculiarity rarely seen in a crinoid. There are twenty ovarian pores situated close to the ambulacral openings; one on each side of the double arm openings and one on each side of the single arm openings.

The arrangement of the arms, in this species, is different from that in *D. bellulus* and *D. aureatus*, where each of three rays bear three arms and the other two bear four arms each, beside important differences in form and surface ornamentation. These are the only species that have been described that bear seventeen arms, and it is quite unnecessary, therefore, to make further comparisons.

Found by Geo. K. Greene, in the Hamilton Group, near Charlestown, Indiana, and now in the collection of Wm. F. E. Gurley.

DOLATOCRINUS ARGUTUS, n. sp.

***Plate III**, **Fig.** 4, basal view; **Fig.** 5, azygous side; **Fig.** 6, summit view.*

Species rather below medium size. Calyx bowl-shaped, subpentagonal, concave below; radial ridges broadly rounded; plates highly convex and slightly radiately ridged toward the margins. Column small and round.

Basal disc pentagonal, depressed; the basal plates are within the cavity of the calyx, in the form of a hollow cone, and the end of the column fills the hollow cone in the superior part, and leaves the basal disc, at the base of the cone, one-half wider than the diameter of the column. First primary radials about as long as wide, abruptly bent in the middle, the lower part forming part of the basal concavity and the superior part curving as abruptly upward. The central part of the plates are tumid rather than nodose and the calyx will rest on the tumid elevations. Second radials quadrangular, a little wider than long and sides nearly parallel. Third primary radials about twice as wide as high, rather smaller than the second primary radials, pentagonal, axillary and support upon each superior sloping side two secondary radials. The second sec-

ondary radials are smaller than the first and the arms in each radial series are drawn close together, leaving wide interradial spaces. There are only ten ambulacral openings, in this species, and they are directed upward so as to be hardly visible in a side view. The second secondary radials are broken away from some of the rays in the specimen illustrated.

The first regular interradials are the largest plates in the body, except the first azygous plate, longer than wide, and have nine sides. They are most tumid at the upper third. The second regular interradials are about one-third as large as the first, heptagonal, and the two superior sides unite with two elongated plates belonging to the vault and the two short superior lateral sides unite with small plates that form part of the covering for the ambulacral channels. The azygous area is larger than the regular interradial areas and the first plate is the largest in the body. It is followed by three plates in the second range, the two lateral ones being small and quadrangular, while the middle one is large and heptagonal. The lateral plates each abut upon a small plate that forms part of the covering of an ambulacral channel, and the middle one abuts upon two of these plates and upon two elongated plates that belong to the vault.

The vault is very slightly convex and is depressed in the interradial areas and bears a short subcentral proboscis. It is covered by two circles of plates and two or three small intercalated ones. The plates appear to have been granular. There are ten ovarian apertures; one on each side of each pair of arms and near the ambulacral openings.

This species most resembles *D. bulbaceus*, but differs in form by being less globular, wider in proportion to its height, in having a shallower concavity below and less elevated vault. But the most distinctive difference is in the azygous areas. In *D. bulbaceus* the azygous area is like the regular areas and has only one plate, in the second range, while in this species the areas are very different, and there are three plates in the second range. In this species there are ten ovarian pores, and in that species none have been discovered. There is also some difference in the surface ornamentation, so that the two species cannot be mistaken for each other.

Found in the Hamilton Group, at Charlestown, Indiana, and now in the collection of Mr. J. F. Hammell, of Madison, Indiana.

DOLATOCRINUS BELLARUGOSUS, n. sp.

Plate III, Fig. 7, basal view; Fig. 8, side view, azygous area on the left; Fig. 9, summit view.

Species below medium size and elegantly sculptured. Calyx hemispherical, truncated below, and expanding to the free arms. Radial ridges consist of small round ridges crossing the central part of the plates and bearing sharp, elongated nodes in the middle part of each plate. They are not transverse as in *D. bellulus*. The surface is ornamented with very numerous radiating lines that bear sharp small nodes. There are no central nodes on the interradials. Column round, medium size and bears a large cinque foil, columnar canal.

Basal plates form a pentagonal one-fourth wider than the diameter of the column, at the surface, and extend up into the calyx, in the form of a hollow cone, which is filled with the end of the column. First primary radials wider than long and subequal in size. Second primary radials from one-half wider to twice as wide as long, quadrangular. Third primary radials expand to the superior lateral angles, larger than the second primary radials, about one-half wider than long, pentagonal. axillary, and, in one of the rays, on the left lateral side, and, in the one on the right of the azygous area, bear upon each superior lateral side a single secondary radial, which is axillary and supports upon each upper sloping side two tertiary radials, which gives to each of these rays four arms. In each of the other three rays, the third primary radial bears upon one upper sloping side three secondary radials, and upon the other one secondary radial, which is axillary and supports upon each superior sloping side two tertiary radials. In the ray on the left of the azygous area, it is the proximal side of the third primary radial that bears only secondary radials, while the distal side bears the tertiary radials, which is contrary to the usual structure of crinoids. There are, therefore, three arms in each of three rays. The species has seventeen ambulacral openings to the vault, all of which are directed upward, though the last tertiary and secondary radials are directed outward so that each radial series extends above the interradial areas.

The azygous area is like the others except slightly wider between the arms. The first interradials are the largest plates in the calyx, have nine sides and are broadly truncated above for the second interradials. The second interradials are less than one-fourth as large as the first and extend about to the top of the calyx. Each one is followed by a smaller plate that abuts, each side, against a small plate, that covers part of the ambulacral channel and in front unites with two elongated plates belonging to the vault.

The vault is very slightly convex, depressed in the interradial areas, toward the margin, so that each radial series stands out prominently and bears a short subcentral proboscis. The sutures between the plates are partly obliterated in our specimen, so the artist has not attempted to show any of the plates. There is a very small ovarian aperture close to the ambulacral opening on each side of each pair of arms and on each side of each single arm, which gives to the species twenty ovarian apertures.

This species differs from *D. bellulus*, which it most resembles, in many minor particulars and in some of specific importance. It is smaller, shorter in proportion to its width, the radial series stand out more prominently, at the summit, and the vault is less elevated. The nodes are longitudinally elongated on the surface of this species, and transversely elongated on *D. bellulus*, and the rest of the surface ornamentation quite as different, notwithstanding the resemblance in some particulars. In *D. bellulus* each of the arms adjoining the azygous area bears four arms, in this species the right one bears four arms and the left one three arms. In this species, the ray on the left of the series opposite the azygous area bears four arms, and the corresponding ray in *D. bellulus* bears only three arms. There are other differences but these are sufficient to distinguish the species.

Found by J. F. Hammell in the Hamilton Group, near Charlestown, Indiana, and now in the collection of Wm. F. E. Gurley.

DOLATOCRINUS CHARLESTOWNENSIS, n. sp.

Plate III, Fig. 10, basal view; Fig. 11, summit view; Fig. 12, azygous side view.

Species medium or above medium size and handsomely sculptured. Calyx subhemispherical or subcylindrical, broadly truncated at the base and constricted below the arms. Rounded radial ridges have more or less elongated nodes at the center of the plates. Small ridges radiate from near the center of the plates, but they do not commence at the nodes or radial ridges. A smooth space is left between the radial ridges and the commencement of these radiating ridges, and the radiating ridges do not commence at a node on the interradial plates. The column is round and has a very large cinque foil columnar canal.

Basal plates form a hollow cone within the cavity of the calyx. The column fills the cone so that the diameter of the column is nearly equal to the diameter of the pentagonal basal disc. First primary radials nearly as long as wide and subequal, in size. Second primary radials quadrangular and nearly as long as wide. Third primary radials expand to the superior lateral angles. They are considerably larger than the second, pentagonal, axillary, and in one of the lateral rays bears upon each upper sloping side a single secondary radial which is axillary and bears upon each superior sloping side two tertiary radials which gives to this ray four arms. In the other lateral ray, the third primary radial supports upon each superior sloping side three secondary radials, which gives to it only two arms. In the rays on each side of the azygous area and in the ray opposite the azygous area, the third primary radial supports upon one of its superior lateral sides three secondary radials, and upon the other a single secondary radial, which is axillary, and supports upon each upper sloping side two tertiary radials, which arrangement gives to each of these three rays three arms. There are, therefore, fifteen arms, in this species. Upon the right side of the azygous area the third primary radial supports, upon its proximal side, three secondary radials; but on the left side of the azygous area, it is the distal side of the third primary radial, that supports the three secondary radials.

The azygous area is like the other interradial areas. The first interradials are pentagonal and much smaller than they generally are, in specimens of the same size, in this genus. They are broadly truncated above for the second interradials. The second interradials are about two-thirds as large as the first and are followed by a much smaller plate in the third range, that separates the arms and unites with two large and elongated plates that belong to the vault.

The vault is only slightly convex, and equally as much depressed, in the interradial areas, toward the margin. It is covered by two circles of plates and a few intercalated ones, the surface of which is covered with granules and small nodes. It bears a small subcentral proboscis which seems to be complete in the specimen illustrated. There is a small ovarian than one-fourth as large as the first and extend about to the top of the calyx. Each one is followed by a smaller plate that abuts, each side, against a small plate, that covers part of the ambulacral channel and in front unites with two elongated plates belonging to the vault.

The vault is very slightly convex, depressed in the interradial areas, toward the margin, so that each radial series stands out prominently and bears a short subcentral proboscis. The sutures between the plates are partly obliterated in our specimen, so the artist has not attempted to show any of the plates. There is a very small ovarian aperture close to the ambulacral opening on each side of each pair of arms and on each side of each single arm, which gives to the species twenty ovarian apertures.

This species differs from *D. bellulus*, which it most resembles, in many minor particulars and in some of specific importance. It is smaller, shorter in proportion to its width, the radial series stand out more prominently, at the summit, and the vault is less elevated. The nodes are longitudinally elongated on the surface of this species, and transversely elongated on *D. bellulus*, and the rest of the surface ornamentation quite as different, notwithstanding the resemblance in some particulars. In *D. bellulus* each of the arms adjoining the azygous area bears four arms, in this species the right one bears four arms and the left one three arms. In this species, the ray on the left of the series opposite the azygous area bears four arms, and the corresponding ray in *D. bellulus* bears only three arms. There are other differences but these are sufficient to distinguish the species.

Found by J. F. Hammell in the Hamilton Group, near Charlestown, Indiana, and now in the collection of Wm. F. E. Gurley.

DOLATOCRINUS CHARLESTOWNENSIS, n. sp.

Plate III, Fig. 10, basal view; Fig. 11, summit view; Fig. 12, azygous side view.

Species medium or above medium size and handsomely sculptured. Calyx subhemispherical or subcylindrical, broadly truncated at the base and constricted below the arms. Rounded radial ridges have more or less elongated nodes at the center of the plates. Small ridges radiate from near the center of the plates, but they do not commence at the nodes or radial ridges. A smooth space is left between the radial ridges and the com-ondary radials, which gives to each of these rays two arms. There are, therefore, sixteen arms and sixteen ambulacral openings to the vault in this species.

The interradial areas are substantially alike. The area between the two-armed rays is slightly more bulged than the other areas, and the first plate is somewhat larger than it is in the others, which indicates that it is the azygous area. The first interradials are the largest plates in the body, have nine sides, and are broadly truncated above for the second interradials. The second interradials are short and wide and the superior part curves in and unites with the plates of the vault.

The vault is only slightly convex over the central part and radial areas, and is very much depressed toward the margin, in the interradial areas, so that the radial areas stand up and project beyond the margin of the calyx and have the ambulacral openings directed upward, The plates over the junction of the ambulacral canals bear nodes and the other plates are tubercular, but our specimens show them somewhat eroded and the sutures between the plates can only be, in part, traced, and for those reasons these features are not shown in the illustrations. There are sixteen ovarian apertures, one close by the side of each ambulacral opening to the vault.

This species would seem to be more nearly related to *D. salebrosus*, than to any one hitherto described, but the base is depressed, in that species, and truncated and the vault elevated more than in this, so that they may readily be distinguished by the form. The surface ornamentation too is somewhat different in the two species, and so are the interradials, and in that species no ovarian pores have been discovered. ered. But the arm formula alone is sufficient to distinguish them. and to separate this from all other described species. In *D. salebrosus*, the arm formula is 4+4+3+3+2=16. In this species it is 4+4+4+2+2=16. The azygous area in that species, if it has any, is between the four-armed rays, and in this between the two armed rays.

Found by Geo. K. Greene, in the Hamilton Group, near Charlestown, Indiana, and now in the collection of Wm. F. E. Gurley.

DOLATOCRINUS APLATUS, n. sp.

Plate III, Fig. 16, basal view; Fig. 17, summit view; Fig. 18, side view. The suture lines are too indistinct on the vault of our specimens for illustration.

Species medium size, very short or much depressed, vault and calyx subequal in capacity. Calyx low, more than three times as wide as high, rounding out from a deep basal cavity and spreading, without any constriction, to the free arms. Surface deeply sculptured. Radial ridges very small but made somewhat conspicuous by the elongated nodes at the center of each plate.

Basal plates within the cavity of the calyx and extending as high as the base of the free arms. First primary radials are entirely within the basal concavity. Second primary radials short, quadrangular, two or three times as wide as high. Third primary radials, short, pentagonal, axillary and each supports on one of the superior sloping sides four secondary radials, and upon the other a single secondary radial which is axillary and bears upon each upper sloping side four tertiary radials, by which arrangement, there are three arms to each ray. There are, therefore, fifteen arms in this species, and fifteen ambulacral openings to the vault.

The azygous area is like the other areas. The first interradials are somewhat elongated, have nine sides and are broadly truncated above for the second interradials. Instead of a central node, on each plate, there is a central excavation, from the margin of which the plates are radiately sculptured. The second plate is sbout one-fourth as large as the first and it is followed by two small plates in the third range that unite with the plates of the vault.

The vault is subconical and bears a subcentral orifice at the summit. Probably the orifice might be said to be at the top of the proboscis, but the proboscis is not the sixteenth of an inch high, and hence, appears only as a slight elevation for the azygous opening. The sutures on the vault, in our specimens, are so badly obliterated that it is impracticable to attempt to describe the plates. There are four ovarian slits between each radial series, and two between each of the ambulacral openings, which arrangement gives to this species forty ovarian apertures.

This species is distinguished by its depressed form, peculiar, sculptured ornamentation, three arms to each radial series, and forty ovarian apertures. The slightest observation will enable any one to distinguish it from all other fifteen-armed species.

Found by Geo. K. Greene in the Hamilton Group, near Charlestown, Indiana, and now in the collection of Wm. F. E. Gurley.

FAMILY CYATHOCRINIDÆ.

CYATHOCRINUS WALDRONENSIS, Miller & Dyer.

Plate III, Fig. 19, azygous view; Fig. 20, opposite view. The specimen is compressed laterally, and magnified two diameters.

This specimen was described, in 1878, in "Contributions to Palæontology No. 2," page 6, from a specimen that did not show the interradials or azygous plates, and which was poorly illustrated on plate IV, Fig. 9, from a specimen then owned by the late C. B. Dyer. The species is extremely rare and we are glad to be able to refigure it, from a better specimen than the original, though it is the second specimen we have ever had the opportunity to examine.

Calyx forms a cup one half wider than the height, and having the basals sunk within the cavity of the calyx. Surface granular. Column small and round.

Subradials of unequal size, longer than wide and curving into the small columnar cavity where they abut upon the basals. The azygous one is larger than either of the others. The first primary radials are larger than the subradials and about twice as wide as long. The second primary radials are very short and quadrangular. The third primary radials are about the size of the second, pentagonal, axillary and support upon the upper sloping sides the free arms. There are, therefore, ten arms, in this species. Above the first two plates the arms are composed of a double series of interlocking plates. The arms are coarse, wide, and short.

A single interradial, in each area, curves in upon the vault. The azygous plate is longer than wide, truncates a subradial, stands nearly vertical and extends as high as the third primary radial.

The specimen here illustrated and described was found in the Niagara Group near Hartsville, Indiana, by Dr. M. N. Elrod and is now in the collection of Wm. F. E. Gurley.

CYATHOCRINUS BLAIRI, Miller & Gurley.

Plate III, Fig. 21, azygous side view of an entire specimen; Fig. 22, summit view of the same specimen.

The authors described this species last year in Bulletin No. 7 of the Illinois State Museum of Natural History, p. 67, and illustrated it on platé IV, figs. 11 to 15, but at that time, only the calyx was known. Since that time Mr. R. A. Blair has found a complete specimen which we are able to illustrate. If, from any cause, it was dwarfed, at the superior end, we are unable to detect it; for it appears to be normal.

The entire body with arms closed is spheroidal. The second radials are as wide as the first, very short and quadrangular. The third radials are nearly as wide as the second, short, pentagonal, axillary, and support on each upper, sloping side two secondary radials, which gives to the species ten arms. The secondary radials are not of uniform size, but they are so constructed and arranged as to cover the vault, seemingly, as close as vault plates would cover it, except a small round spot at the center, which looks like the azygous orifice. The depressions on the summit between the radial series, gives it a slight pentalobate aspect when viewed from above. The second azygous plate is semicircular with the arcuate side up and is so closely surrounded above the first plate, by the radials, that it looks like a plate forming part of the vault.

We have never before seen arms resembling those in this species, unless those in the *Ichthyocrinidæ* might be said to have some similarity. The comparison, however, is remote. Even the calyx suggested that it might not prove to belong to *Cyathocrinus*, and that doubt is increased by this complete specimen. We do not, however, discover characters that we call generic, to distinguish it. It is a very singular species.

Found by R. A. Blair, in the Chouteau limestone, at Sedalia, Missouri, and now in the collection of S. A. Miller.

FAMILY GLYPTASTERIDÆ.

THYSANOCRINUS MILLIGANÆ, n. sp.

Plate III, Fig. 23, basal view, the basal plates being in a pit and substantially hidden by the column; Fig. 24, azygous side; Fig. 25, opposite view.

Species medium or above medium size. Calyx bowl-shaped, broadly truncated below and slightly expanded above. Pentagonal in transverse section or as seen from above or below. Plates thick and deeply sculptured. Surface granular. Column small.

Basals small, deeply sunken in the basal concavity so as to be hidden by the column. Subradials large. They bend into the basal concavity and up on the outside of the calyx, where the height appears to be nearly equal to the width. They terminate below in pyramidal points on which the calyx will rest, if placed on a table, and which extend laterally so as to give a pentagonal outline to the base of the calyx. First primary radials twice as wide as long and bear a subcentral transverse ridge, having raised lines directed to the angular ridges on the subradials below. Second primary radials short, quadrangular, five or six times as wide as long. Third primary radials a little larger than the second, pentagonal, axillary and bear upon each superior sloping side a secondary radial, which gives to this species ten arms.

There are three regular interradials in each area. The first one rests between the superior sloping sides of the first primary radials and bears a central elongated node. It is followed by two narrow elongated plates that curve over upon the vault. The first azygous plate is large, truncates a subradial and bears a large central node. It is followed by three plates, the middle one truncating it slightly. They curve over upon the vault.

Vault and arms unknown.

This species is quite different, in form and surface markings, from all other described *Thysanocrinus*, but it substantially agrees with the generic formula, so far as it is preserved, and we have, therefore, very little doubt about the generic reference.

Found by Mrs. J. M. Milligan, in whose honor we have proposed the specific name, in the Niagara Group, of Decatur County, Tennessee, and now in her collection.

FAMILY ICTHTHYOCRINIDÆ.

LECANOCRINUS GREENEI, n. sp.

Plate III, Fig. 28, azygous side view of body, arms, and part of the column.

Species medium size; general form, with the arms closed, obovate Surface smooth or granular. Column composed of rather thick plates.

Basals form a low cup having a diameter at the top nearly one half greater than the diameter of the column and truncated below the full diameter of the column. Subradials large, nearly as long as wide and gradually expanding. First primary radials of unequal size and about twice as wide as long. Second primary radials short, quadrangular, one-third as large as the first, three or four times as wide as long. Third primary radials a little larger than the second, pentagonal, axillary, and bear upon each upper sloping side the secondary radials. The number of secondary radials is not uniform. In one of the rays shown in our specimen there are three secondary radials and in the other three rays there are four secondary radials, the last being axilliary, which gives to the speoies twenty arms. Some of the arms probably bifurcate again.

There is an elongated, octagonal interradial plate on the right side of our specimen, resting between the superior sloping sides of a first primary radial and a second primary radial, and separating the primary radials and one secondary radial, on one side, from the second and third primary radials and the first and second primary radials, on the other. An interradial may be seen on the left side of the specimen that appears to occupy the same position. The azygous interradial broadly truncates a large subradial and separates the primary and first secondary and part of the second secondary plates, that abut against it, giving to it eleven sides. If there are two azygous plates in this species, as is usual in the genus, the suture, that separates one from the first primary radial on the right, is obliterated, in our specimen.

The regular interradials, in this species, constitute a marked peculiarity, the azygous plate too is different from all others. It may also be distinguished by its general form.

Found by George K. Greene, in whose honor the specific name is given, in the Niagara Group near Louisville, Kentucky, and now in the collection of Wm. F. E. Gurley.

FAMILY SYNBATHOCRINIDÆ

SYNBATHOCRINUS ILLINOISENSIS, n. sp

Plate III, Fig. 29, basal side view of Calyx; Fig. 30, azygous side view of same; Fig. 31, Summit view of same.

Species from medium to large size. We have a specimen about two-thirds as large as the one illustrated. Arms unknown. Calyx truncated for a large column, broadly constricted in the middle part, where it is evenly rounded, and subpentagonal at the top, by reason of the straight, transverse, superior sides of the first radials. About twice as wide as high. Sutures slightly beveled. Surface granular.

Basals form a cup three times as wide as high, having a concave base for the attachment of a large column and a pentagonal outline above for the support of the straight inferior sides of the first radials. First radials one-third wider than high, gradually expand from the base to the top which is truncated the entire width, on three of the plates for the reception of the second radials. The other two plates are slightly truncated, at one angle, for the reception of the azygous plate. Three of them, therefore, are quadrangular and the other two pentagonal. The superior face of each plate is very deep and bears an angular node, at each internal angle, with a flange at the border of the internal cavity, notched at the middle for the ambulacral furrow. There is a straight furrow, half the width of the plate, just within the outer margin, for the articulation of a ridge on the second plate. The central cavity is pentalobate.

The general form of the calyx of this species readily distinguishes it from all heretofore described. The rounded and constricted body will alone suffice to separate it from all others. It is not practicable, therefore, to compare it with any other.

Found in the Burlington Group, in Adams county, Illinois, by C. S. Hodgson and now in the collection of S. A. Miller.

FAMILY TAXOCRINIDÆ.

FORBESOCRINUS WASHINGTONENSIS, n. sp.

Plate III, Fig. 32, azygous view of a specimen laterally compressed; Fig. 33, view, opposite the azygous area, of another specimen.

Species medium size; plates highly convex; transverse sutures nearly straight in the calyx but becoming slightly arcuate toward the ends of the rays. Calyx constitutes two-thirds of the body. It is wider than high. The interradial areas are slightly depressed so as to make the calyx obpyramidal above the truncated base. The arms rapidly contract above the calyx and are infolded at the ends. Column tapers rapidly below the calyx where it is composed of very short plates.

Basals sunk within the calyx. Subradials small, three heptagonal, two hexagonal. Primary radials four in each series, three or four times as wide as high; the last one is axillary and supports upon each upper sloping side three secondary radials, the last one of which is axillary and supports upon each upper sloping side tertiary radials. The secondary radials are as long as the primary radials, but not quite as wide. The tertiary radials vary in number, in the different rays, from four to nine. In the proximal series, on the left of the azygous area, there are eight plates, in the next series four; and in the proximal series, on the right of the azygous area, there are six plates, and in the next series five. In the ray opposite the azygous area the distal series have nine plates each and the proximal series have six in one and seven in the other. The number of tertiary plates vary, in like manner, in the other two rays The last tertiary radials are axillary and the proximal rays do not divide. but each distal quaternary series bears an axillary plate and supports the fifth series on each of its superior sides. The number of quaternary plates in the various distal series varies from nine to twelve. There are. therefore, twelve arms to each ray, or sixty arms in this species.

The regular interradial areas are long and narrow, and the plates vary in number in the different areas, as shown in our specimens, from twelve to sixteen. The first plate rests between the superior sloping sides of the first primary radials. It is succeeded by five ranges of two plates each, and above these there are from one to five single plates, one above the other, so that the last one extends up to the third or fourth tertiary radials. The intersecondary areas have from five to seven plates. There is one rather large plate, followed by either one or two ranges of two plates each, and above these there are two or three plates, one above the other. There are no intertertiary radials. In the azygous area two plates truncate a subradial, which is more than twice as large as either of the other subradials. There are three plates in the second range, four in the third range, which is at the widest part of the area. Above the third range the plates are irregular in size and not placed in ranges, and number about twelve, the last one of which reaches to the second tertiary radials. The whole number is about twenty-one.

This species most resembles *F. speciosus* from the same locality; but, while this species is larger, it has not as many regular interradials, fewer secondary radials, and no intertertiary radials. The azygous areas are altogether different, and so also are the subradials, at the base of the areas. This species has sixty arms, while that species was described as having only forty. The transverse sutures, too, in that species, are much more arcuate than in this. The two species cannot be mistaken for each other.

Found in the Keokuk Group, in Washington County, Indiana, and now in the collection of Wm. F. E. Gurley.

FORBESOCRINUS MULTIBRACHIATUS, Lyon & Casseday.

Plate IV, Fig. 1, diagrammatic view, copied from Sidney S. Lyon's original drawing, by his son, Victor W. Lyon.

This species was not illustrated by the founders of it, though some drawings of it were made, and, as a natural consequence, other species have been confounded with it. The errors arising from the want of illustration evidences the imperative necessity of disregarding all definitions of species that are not accompanied with illustrations, where a later author has properly described and illustrated them. Where, however, as in this case, no one has made a synonyn, it is eminently proper to illustrate the species, so that it may stand, as of the date of the publication, in the American Journal of Science and Arts, 2d Ser., Vol XXVIII, p. 235, in 1858. Sidney S. Lyon and S. A. Casseday wrote very full and accurate descriptions, and, for this further reason, it affords us pleasure to be able to furnish an authentic illustration of this species. It is very doubtful about there being any generic distinction between *Forbesocrinus* and *Taxocrinus*, and, hence, we find this species sometimes referred to *Taxocrinus* and at other times to *Forbesocrinus*. And again it is doubtful which word has priority, in proper definition and illustration, though the name, *Taxocrinus* was first proposed. If both genera are to stand, we are inclined to think this species was correctly referred, by its author, to *Forbesocrinus*. The species described by White under the name of *Taxocrinus multibrachiatus* var-*colletti*, is not a mere variety of this species. It is a valid species and must be known as *Taxocrinus colletti*, if the genus *Taxocrinus* is retained.

We here copy Lyon and Casseday's specific description in full, as follows:

"Body subglobose, where the arms are folded inward as usually the case; from the base to the free arms somewhat discoid, robust, externally covered with minute granules.

"Basal pieces, three, similar in form and sizes forming by their margin apparently the upper joint of the column, slightly thickened opposite the middle of the species.

"Subradial pieces, five, in good specimens presenting five obtusely angular pieces disconnected from each other, resting apparently upon the supra columnar piece.

"Radial pieces first series. Generally four in each ray, the first five (resting between the angular points of the subradials) are irregular in size and form, four are irregularly hexagonal, twice as wide as high, the fifth pentagonal and much smaller than either of the other. The second and third radials are obscurely hexagonal, similar in form, differing slightly in size; the fourth is axillary, obscurely six sided, rising into a long angular point; on each of its oblique upper sides supporting three pieces of the secondary radials, which are similar in form and nearly as large as the first radials. The last of these being axillary, support on their upper oblique margins, each from four to seven brachial pieces; these last are again axillary and bear on one side a branch of from 25 to 30 pieces, on the other branch, which is again divided on the sixth or seventh piece above the first division of the arms, each branch of this last division being composed of about 20 pieces.

"*Interradial fields 1st series.* These fields consist of about fifteen pieces each, the first of which rests upon the upper oblique margin of the first series. Usually hexagonal, small, this supports two of the second row, similar in form and size; these last again support three of the third row of the same form, but a little larger; these again a fourth row differing slightly in form and size, which are followed by two superior rows of ten pieces each of irregular forms, sometimes there is another at the summit of which completes the field.

"*Interradial fields of the 2d series.* Five, composed of pieces similar in form, from six to seven in number, variously arranged, sometimes one surmounted by two similar pieces, these by two others, then a smaller one or one at the base, with one above the other, these again by two ranges of two, then one, all these forms are occasionally found in the same specimen.

"*Interradial fields of 3d series.* Usually ten, composed of from three to five pieces not regular in form or arrangement, occasionally some of the fields are obscure or absent.

"*Anal pieces six.* The first is septagonal and rests upon the large subradial; upon it are two pieces, nearly similar in size; in the angle formed by their junction is one irregular shaped piece supporting two quite small quadrangular ones.

"The arms are twenty in number, of irregular length, each branch divided into three fingers, making sixty in all. They are free from the third or fourth piece of the third division.

"The arrangement of the several series of interradial fields between the branches of the arms produces a very large cup in proportion to which the rays are quite short. The general form of our species is somewhat like that of *Ichthyocrinus lœvis* (Courad) Hall's figure, New York Geol. Rep. pl. 48 fig. 2. In the arrangement of the rays and the interradial fields in three series it approaches *Forbesocrinus wortheni* Hall (Iowa pl. 17, fig. 5) from which it differs widely in the number of anal pieces.

"Our specimens are nearly perfect, none of them exhibit the patelloid pieces of *F. Wortheni* Hall. In several species of this genus which have come under our observation there are no patelloid pieces, in a few of our specimens (the prolongation of the superior pieces near the center of their breadth overlapping the inferior) some of the prolongations are fractured; specimens of this character have probably led to the remark of Mr. Hall before cited. It is highly probable that this prolongation in the living animal was less calcareous than the remainder of the piece and owing to this circumstance was differently mineralized from the mass of the piece. This very difference, in the composition of the pieces, supposing that the prolongation was cartilaginous and the rest of the piece bony, would give flexibility to the body of the calyx and would have been especially useful to our similarly arranged species, whose rays are soldered together by the intercalation of three stories of intermedial and interbrachial fields.

"Our figures are drawn the size of nature from the largest perfect specimens that have come under our notice; fragments have been found of larger individuals.

"*Geological position and locality.* Rare in the beds of the subcarboniferous limestone near to the top of the Knob sandstone, Clear Creek, Hardin county, Kentucky. Also in the same beds in Washington and Montgomery counties, Indiana. Vertical range unknown; it is probable that it is quite limited."

We are inclined to believe that the species was collected in Hardin county, Kentucky. We have not found it in Indiana.

FORBESOCRINUS JERSEYENSIS, n. sp.

Plate IV, Fig. 2, azygous side of a compressed specimen; Fig. 3, opposite side of same, but the overlapping middle part of the plates has been more or less eroded.

Species large; plates moderately convex; middle part of the plates overlap the inferior plates, but where eroded the sutures appear to be nearly transverse. Calyx constitutes full two-thirds of the body and is about as wide as high. Interradial areas slightly depressed. Arms slowly contract; they are long and slender above the tertiary series and are infolded at the ends. Column tapers rapidly below the calyx, where it is composed of very thin plates.

Basals within the calyx. Subradials small. Primary radials four in each series, between two and three times as wide as long, the last ones are axillary and support upon each upper sloping side the secondary radials. There are three secondary radials in each series. They are somewhat shorter and narrower than the primary radials. The last ones are axillary and support, upon the upper sloping sides, the tertiary radials. The tertiary radials vary, in number, in the different rays from five to eight. In the proximal series, on the left of the azygous area, there are eight plates, and in the next series five. In the proximal series on the right of the azygous area there are seven plates, and in the next series five. In each ray there are four to six tertiary plates in the proximal series and seven or eight in the distal series. The last tertiary radials are axillary and the proximal rays do not divide, but each distal quaternary series bears an axillary plate and supports the fifth series on each of its superior sides. The number of quaternary plates in the different distal series varies from nine to twelve. There are, therefore, twelve arms to each ray or sixty arms in this species

The regular interradial areas are of unequal size, some have only two longitudinal series of plates and others have three. The plates vary in number, in the different areas, from eleven to eighteen, An area having only eleven plates is shown in figure 3 and one having eighteen plates is shown in figure 2. The intersecondary areas are elongated and have from six to nine plates. The intertertiary areas are elongated and have either three or four plates, one following the other. In the azygous area two large plates truncate a subradial, and they are followed by two large plates, and above these, there are three or four plates in a range until the area begins to contract. The superior part of this area is injured in our specimen so that the exact number of plates it contains cannot be determined.

This species resembles *F. multibrachiatus*, in the structure of the arms, as far as the tertiary radials, but above that, there is considerable difference. The interradial areas differ in form and in the number of plates and the azygous areas are widely different. It, however, bears a closer relationship with that species than with any other. The difference in the interradial and azygous areas also makes the two species differ in the form of the calyx.

Found by the late Prof. Wm. McAdams, in the Warsaw Group, in Jersey county, Illinois, and now in the collection of Wm. F. E. Gurley.

TAXOCRINUS UNGULA, *n. sp.*

Plate V, Fig. 1, azygous view; Fig. 2, opposite side of the same specimen.

Species large and the arms have a fanciful resemblance to numerous claws. The radial series stand out from the interradial areas, and are regularly rounded. The interradial areas are much depressed, and do not extend half the length of the body, including the arms. There are one hundred arms infolded at the summit. The middle part of each plate overlaps the inferior plate externally, in a sinuous line, as in other species. Surface coarsely granular. Column very large, and tapers rapidly below the calyx, where it is composed of very thin plates.

Basals within the calyx. Subradials medium, or rather more than medium size. Primary radials, four in each series, a little more than twice as wide as long, gradually taper upward and become shorter. They are rounded externally. The last ones are axillary, and support upon the upper sloping sides the secondary radials. There are three secondary radials in each series, except in one of the lateral rays, where there are only two, as shown by figure 2. The last ones are axillary, and support upon the upper sloping sides the tertiary radials. The tertiary radials vary from three to six in the different series. In each of the rays adjoining the azygous area there are three tertiary radials in one and four in the other proximal series, and five in each of the distal series. One of the lateral rays is constructed in the same way, except there are four plates in each of the proximal series. The other lateral ray has six plates in each of the distal series. In the ray opposite the azygous area there are six plates in one of the distal series, otherwise it is like the rays adjoining the azygous area. The last tertiary radials in each series are axillary, and support the fourth series. The distal rays again divide, and each branch of the latter again divides, so that there are twenty arms to each ray. There are, therefore, one hundred arms that curve over upon or infold upon the summit of this species.

The interradial areas are depressed, and differ greatly in size. The plates graduate into those of the vault without any distinct line of separation. The first plate rests between the superior sloping sides of the first primary radials; it is followed by a single plate in one of the areas, by two plates in two of the areas and by three plates in the other area. Above the second range there are two plates, in the third range, in one area, three, in two areas, and four, in the other area. Above the third range the plates are more numerous, and while they unite with the secondary radials, the central ones are much depressed and graduate into those of the vault. The intersecondary areas differ in like manner in size and number of plates. In one area there is only one plate, in the second range, in another there are two, and in another there are four. They so curve in upon the vault that they cannot be distinguished in our specimen beyond the second range. There is one plate in each intertertiary radial area, but it is small and directed toward the vault.

The first azygous plate broadly truncates a subradial, the sides are nearly parallel, and it supports two plates in the second range, one of which only slightly truncates an angle on the left, while the other rests upon the longer, superior, inclined side and supports a series of rather large convex plates. On the right of this series there are some small plates that unite with the primary radials, above the first plate, and on the left there are larger plates connecting the plates with the primary radials. The area curves into the vault so rapidly that none of the plates are shown in our specimen beyond the fourth range.

This species will be readily distinguished from all others, by its general form, and one hundred arms. If *Taxocrinus* is distinguished from *Forbesocrinus*, by supporting, in the azygous area, a central or subcentral series of plates, this is a *Taxocrinus*, but if that is not the generic difference, it might as well be called a *Forbesocrinus*.

Found in the Keokuk Group, at Crawfordsville, Indiana, and now in the collection of Wm. F. E. Gurley.

TAXOCRINUS SPLENDENS, n. sp.

Plate V, Fig. 3, azygous area on the right; Fig. 4, opposite side of the same specimen, which is compressed.

Species medium size. The radial series stand out from the interradial areas and are broadly rounded. Interradial areas depressed. There are sixty arms infolded at the summit. The middle part of each plate overlaps the inferior plate externally, in a sinuous line, which is more conspicuous than usual in this genus. Surface pustular. Column tapers very slightly from the calyx where it is composed of very thin plates.

Basals within the calyx. Subradials medium size. Primary radials, four in each series, and they gradually widen from the subradials to the secondary radials, which is the reverse of what we usually find in this genus. They do not increase, correspondingly, in length. The last ones are axillary and support upon the upper sloping sides the secondary radials. There are three secondary radials in each of five series and four in each of the other five, as follows: In the ray on the left of the azygous area three in each series; in the ray on the right and in the ray opposite the azygous area four in each; in one lateral ray three in each, and in the other lateral rays three in one and four in the other. The last ones are axillary and support upon the upper sloping sides the tertiary radials. The tertiary radials vary from four to ten in the different series, and the arms are not of equal size. The last tertiary radials, in each series, are axillary and support the quaternary radials. The distal rays again divide, which gives to each ray twelve arms. There are, therefore, sixty arms that infold upon the summit of this species.

The interradial areas are depressed, narrow, elongated, and differ in size and number of plates. The plates graduate into those of the vault without any distinct line of separation. The first plate rests between the superior sloping sides of the first primary radials, and is more or less elongated. It is followed by two plates in the second range, but these are more elongated in some areas than in others, and they differ in size. There are three plates in the third range and above these the plates curve over toward the vault, in the central part of the areas, while uniting at the sides with the secondary radials. A small intersecondary plate may be seen in some of the areas directed inward while it evidently unites with the plates of the vault. The azygous area is narrow, the first plate truncates a subradial and supports a series of rounded plates, on each side of which, smaller plates connect it with the primary radial series.

This species is distinguished by its column, expanding primary radial series, number of secondary and tertiary radials, and by the narrow and elongated interradial areas. The pustules on the surface are very large though not shown in the illustrations. There is no described species for which it can be mistaken by anyone competent to make a comparison.

Found in the Keokuk Group, at Crawfordsville, Indiana, and now in the collection of Wm. F. E. Gurley.

FAMILY PLATYCRINIDÆ.

PLATYCRINUS ILLINOISENSIS, n. sp.

Plate V, Fig. 5, basal view of calyx; Fig. 6, side view of same; Fig. 7, summit view of the calyx of a larger specimen.

Species about medium size, though there is considerable difference in size among the specimens collected. Calyx bowl-shaped, subpentagonal, broadly truncated below, sutures deeply beveled, radials longitudinally convex. Surface smooth. Plates thick. Column and arms unknown.

Basals form a pentagonal disc, with a height very little exceeding the thickness of the plates, and being slightly concave on the lower side where the column attaches. The first radials stand nearly upright, and are a little longer than wide. They are broadly convex, the greatest convexity being at the margins of the articulating facets. The articulating facets are semicircular, occupy about half the diameter of the plates, are gently concave and directed upward at an angle of about forty-five degrees. The notch for the ambulacral canal is only faintly indicated on each plate.

The azygous interradial, as shown by the angle for its reception, is much larger than either of the other interradials. The vault is probably high, as indicated by the round cavity and indistinct ambulacral notches, though it is not preserved in our specimens.

We do not know of any species with which this one might be confounded, and, therefore, think it is unnecessary to draw comparisons.

Found by C. S. Hodgson, in the Burlington Group, in Adams county, Illinois, and now in the collection of S. A. Miller.

PLATYCRINUS HODGSONI, n. sp.

Plate V, Fig. 8, basal view; Fig. 9, side view, showing the azygous interradial on the left.

Species large and wonderfully ornamented. Calyx bowl-shaped, pentagonal, very broadly truncated below, sutures beveled, plates flattened. Surface ornamented with numerous pustules along the beveled sutures and irregular rounded nodes over the interior part of the plates. Plates not very thick. Column round. Arms unknown.

Basals form a large, almost flat, pentagonal disc. It is slightly concave where the column attaches. Column round and radiately lined near the margin. The basal disc and radials are ornamented in the same manner. The first radials are a little longer than wide, and stand nearly upright. They are flattened below the articlating facets. The articulating facets are semicircular, or occupy a little more than the space of half a circle, and a little more than half the diameter of the plates. They are deeply concave and radiately lined for the firm attachment of the second plates. The facets are directed upward at an angle of about forty-five degrees. The notch for the ambulacral canal is only faintly indicated on each plate.

The azygous interradial is a little larger than either of the other interradials, stands nearly upright, but the superior end curves in upon the vault. The surface bears a short spine, and is covered with pustules and nodes in the same manner as the other plates of the calyx.

This species is distinguished by its form, surface ornamentation and radiately lined articulating facets.

Found by C. S. Hodgson, in whose honor we have proposed the specific name, in the Burlington group, in Adams county, Illinois, and now in the collection of S. A. Miller.

REMARKS.—We are led, at this time, after an examination of all of the definitions of the various species of Platycrinus described from the palæozoic rocks of North America, and after having examined fossils belonging to nearly all the species, to make the following observations, notwithstanding it would seem to be more appropriate under a discussion of the genus itself. Some species have not been illustrated and have been so poorly defined that they cannot be determined, without comparison with an authentic specimen, just as they could be determined, if there had been no definition, at all, and, therefore, they are not entitled to recognition. There has been no synonymy, where species have been properly described, and, it is quite possible, there has been none in any case. We recognize one hundred and nineteen species of Platycrinus from America.

The two earliest forms are *P. præmaturus* and *P. Siluricus*, from the Niagara Group. They are widely different from each other, and have no resemblance, beyond the generic formula, to any species that followed them. We have no conception of the forms from which they were derived, and are equally in the dark, as to their descendants. If they fall into the life history of *Platycrinus* and all species resulted from evolution, what a world of forms lived in the Silurian and Devonian ages that are yet wholly unknown.

From the Middle Devonian three species have been described, *P. eboraceus*, *P. eriensis*, and *P. leai*. The first two are quite peculiar and the last might seem to be a fitting ancestor to the round, cup, turbinate, or bowl-shaped forms occurring, in the Subcarboniferous of later times.

The next described species are found in the lower group of the Subcarboniferous and principally from the Chouteau limestone. Here we find seventeen species, some of them so widely different from all that preceded them and from all that are known in later rocks, that no resemblance can be traced to any of them, beyond the generic formula. They are as different from a typical Platycrinus as the most extreme form of Eretmocrinus is from the type of Batocrinus. But, in the Chouteau, we find, in *P. colletti* and *P. chouteauensis*, the commencement of the discoid forms that became so abundant, in the Burlington Group, and, in *P. pettisensis*, the commencement of the pentagonal, bowlshaped forms that abounded in the Burlington Group and survived until the Kaskaskia age. The rounded, turbinate and cupshaped forms, however, prevailed.

More than twenty distinct, discoid species, of which *P. cavus*, *P. gorbyi*, *P. occidentalis*, *P. sulcatus*, *P. discoideus*, *P. excavatus*, *P. striaebrachiatus*, *P. sulciferus*, and *P. formosus* are extreme representatives, have been described from the Burlington Group, but none from rocks of later age, if we except *P. pumilus*, from the Warsaw Group, that has a calyx somewhat discoid in outline. Sixteen species having a pentagonal, bowlshaped outline, of which *P. sampsoni*, *P. missouriensis*, *P. wortheni* and *P. hodgsoni* are extreme forms, have been described, from the Burlington Group, and only three from the Keokuk, one from the Warsaw and one from the Kaskaskia. The *Platycrinus* seem to have been in their zenith of development, in the Burlington Group, and to have become extinct, before the close of the subcarboniferous period.

We may divide Platycrinus into discoid, bowlshaped, pentagonal, turbinate, hemispherical and urnshaped forms, for convenience of identification and description. But to propose generic or subgeneric names for such subdivisions would be on a par with those proposed by some authors for Poteriocrinus, and possess no merit, whatever, in a scientific sense; but, on the contrary, would constitute another stake, driven in the path of progress, for every student and naturalist to stumble over, until some one happened along with the strength and courage to pull it up and throw it away. The variety of forms displayed, in Platycrinus, is an evidence of evolution; but until we have become acquainted with many forms that are now unknown and have more correct and settled opinions as to the effect of the environments in shaping the structure of the tests, we can know but little of the life history of the animals.

PLATE I.

Page.

Batocrinus germanus, n. sp. 5
  Fig. 1. Basal view.
  Fig. 2. Azygous side view.
  Fig. 3. Summit view.

Batocrinus proximus, n. sp. 7
  Fig. 4. Basal view.
  Fig. 5. Lateral view.

Batocrinus hodgsoni, n. sp. 8
  Fig. 6. Azygous view.
  Fig. 7. Lateral view.

Batocrinus abruptus, n. sp. 9
  Fig. 8. Azygous view.
  Fig. 9. Opposite side view.

Batocrinus basilicus, n. sp. 11
  Fig. 10. Azygous view.
  Fig. 11. Opposite side view.
  Fig. 12. Summit.

Batocrinus asperatus, n. sp. 12
  Fig. 13. Azygous view.
  Fig 14. Lateral view.

Batocrinus asper, n. sp. 13
  Fig. 15 Basal view.
  Fig. 16. Azygous view.

Agaricocrinus hodgsoni, n. sp. 22
  Fig. 17. Basal view.
  Fig. 18. Summit.
  Fig. 19. Azygous view.
  Fig. 20. Opposite side view.

Agaricocrinus illinoisensis, n. sp. 23
  Fig. 21. Basal view.
  Fig. 22. Summit.
  Fig. 23. Azygous view.

Batocrinus cistula, n. sp. 18
  Fig. 24. Azygous view.
  Fig. 25. Basal view.
  Fig. 26. Summit.

Batocrinus jessiæ, n. sp. 20
  Fig. 27. Azygous view.
  Fig. 28. Summit.
  Fig. 29. Basal view.
  Fig. 30. Lower part of calyx of another (?) example.
  Fig. 31. Azygous view of cast of another.(?)
  Fig. 32. Basal view of same cast.

Batocrinus adamsensis, n. sp. 14
  Fig. 33. Azygous view.
  Fig. 34. Opposite side view.
  Fig. 35. Summit.

Batocrinus folliculus, n. sp. 15
  Fig. 36. Azygous view.
  Fig. 37. Opposite view.
  Fig. 38. Summit.

Batocrinus modulus, n. sp. 16
  Fig. 39. Basal view.
  Fig. 40. Azygous view.
  Fig. 41. Summit.

Batocrinus nanus, n. sp. 17
  Fig. 42. Azygous view.
  Fig. 43. Opposite view.
  Fig. 44. Summit.

Amphoracrinus blairi, n. sp. 26
  Fig. 45. Basal view.
  Fig. 46. Same magnified two diameters.
  Fig. 47. Summit.
  Fig. 48. Same magnified two diameters.
  Fig. 49. Azygous view.
  Fig. 50. Same magnified two diameters.

ILL. STATE MUS. OF NAT. HIST.

Bulletin No. 8. **Plate I.**

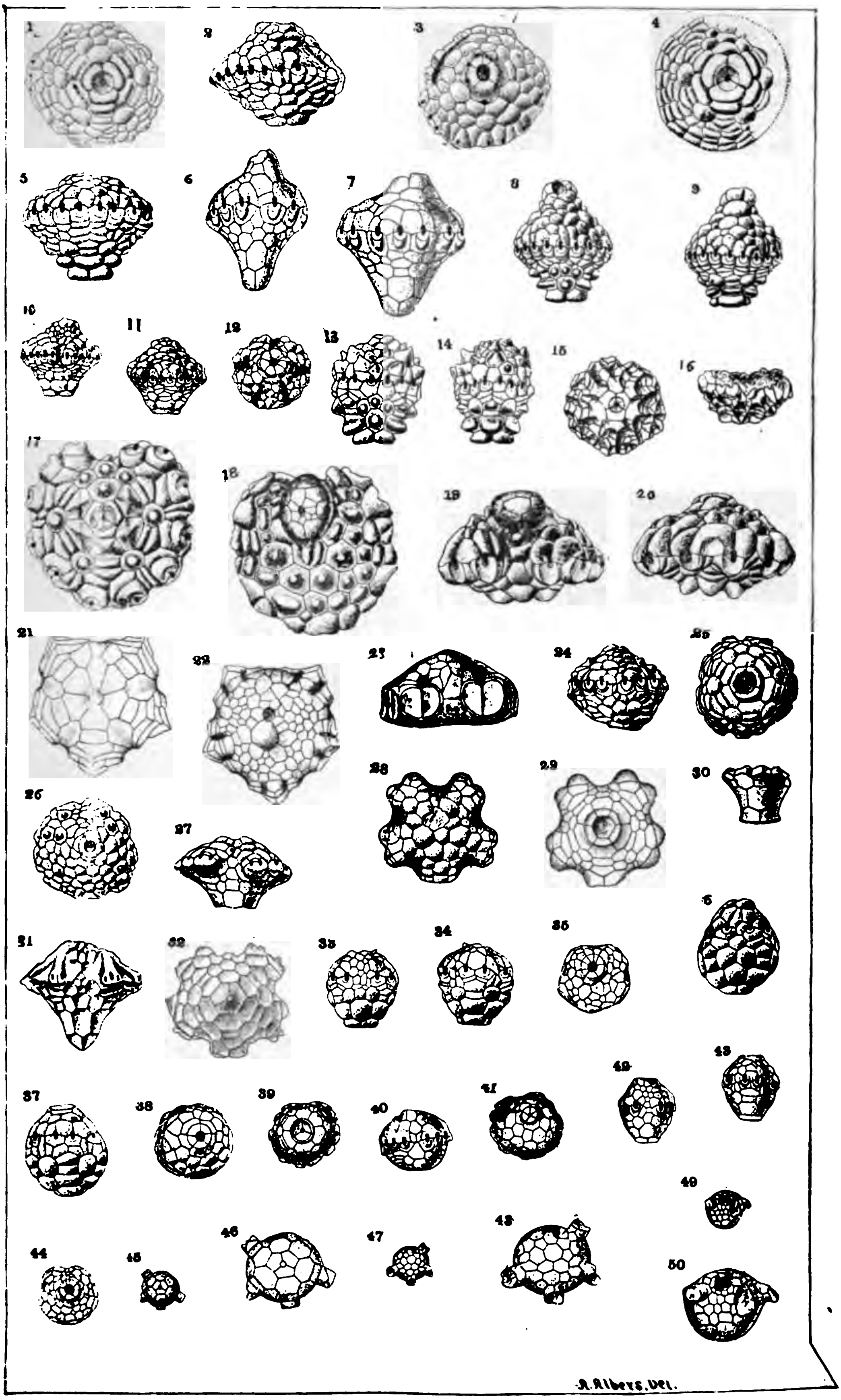


PLATE II.

Page.

Megistocrinus indianensis, n. sp. 27

Fig. 1. Basal view.
Fig. 2. Summit.
Fig. 3. Azygous view.

Steganocrinus spergenensis, n. sp. 29

Fig. 4. Azygous view.
Fig. 5. Opposite side view.
Fig. 6. Basal view.
Fig. 7. Summit.

Batocrinus solitarius, n. sp. .... [illegible]

Fig. 8. Lateral view.
Fig. 9. Azygous view.
Fig. 10. Summit.
Fig. 11. Basal view.

Strotocrinus ornatus, n. sp. 30

Fig. 12. Azygous view.
Fig. 13. Right lateral view.
Fig. 14. Summit.

Actinocrinus jessiæ, n. sp. 33

Fig. 15. Azygous view.
Fig. 16. Opposite side view.

Zeacrinus peculiaris, n. sp. 34

Fig. 17. Azygous side on left.
Fig. 18. Opposite side of same.
Fig. 19. Basal view.

Zeacrinus doverensis, n. sp. 35

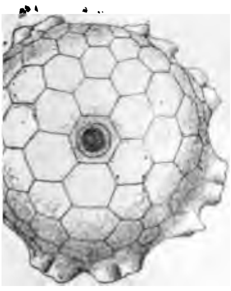
Fig. 20. Azygous side view.
Fig. 21. Opposite side of same.
Fig. 22. Basal view.

Zeacrinus kentuckiensis, n. sp. 37

Fig 23. Basal view.
Fig. 24. View of specimen opposite azygous side.

Barycrinus elrodi, n. sp. 38

Fig. 25. Azygous view.
Fig. 26. Basal view.
Fig. 27. View opposite azygous side.



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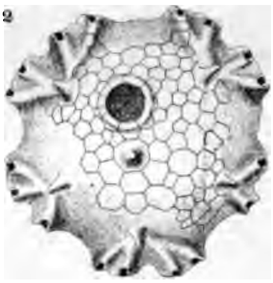

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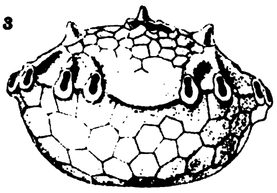

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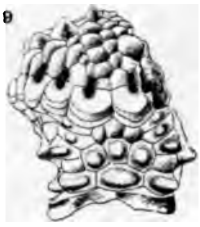

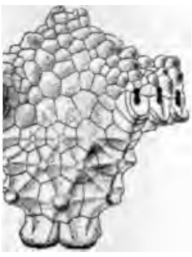

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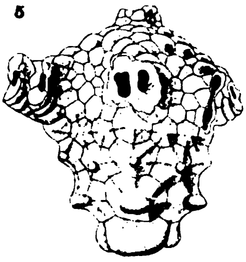

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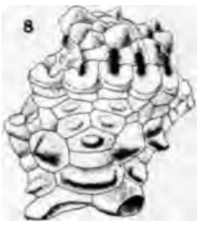

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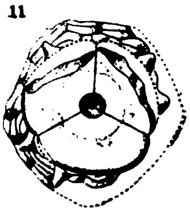

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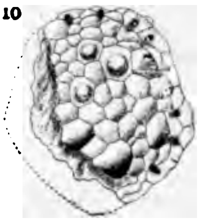

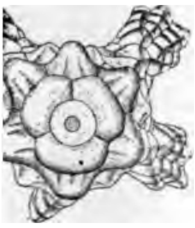

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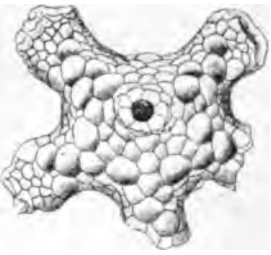

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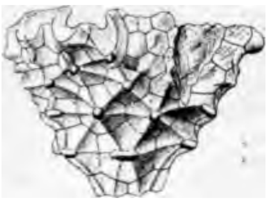

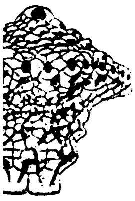

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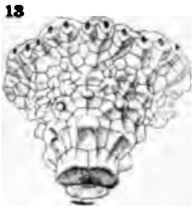

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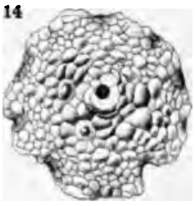

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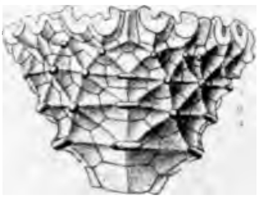

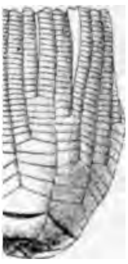

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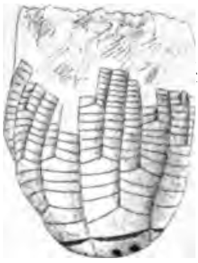

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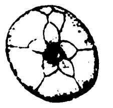

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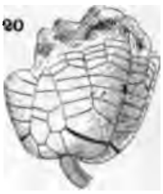

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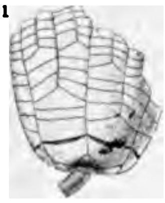

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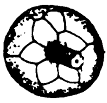

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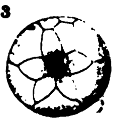

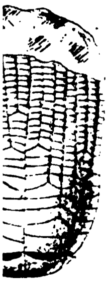

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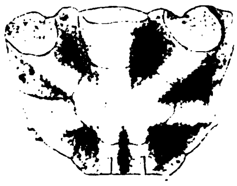

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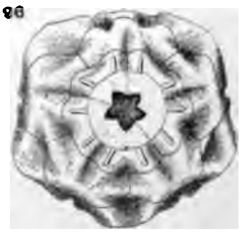

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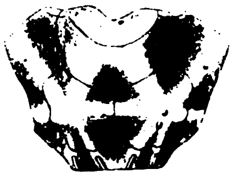

A.Albers. Del.

PLATE III.

Page.

DOLATOCRINUS INDIANENSIS, n. sp. 40

Fig. 1. Basal view.
Fig. 2. Summit.
Fig. 3. Azygous view.

BATOCRINUS ARGUTUS, n. sp. 41

Fig. 4. Basal view.
Fig. 5. Azygous view.
Fig. 6. Summit.

DOLATOCRINUS BELLARUGOSUS, n. sp. 43

Fig. 7. Basal view.
Fig. 8. Lateral view, azygous area on left.
Fig. 9. Summit.

DOLATOCRINUS CHARLESTOWNENSIS, n. sp. 44

Fig. 10. Basal view.
Fig. 11. Summit.
Fig. 12. Azygous view.

DOLATOCRINUS CÆLATUS, n. sp. 46

Fig. 13. Basal view.
Fig. 14. Lateral view.
Fig. 15. Summit.

DOLATOCRINUS APLATUS, n. sp. 48

Fig. 16. Basal view.
Fig. 17. Summit.
Fig. 18. Lateral view.

CYATHOCRINUS WALDRONENSIS, M. & D. 49

Fig. 19. Azygous view.
Fig. 20. Opposite side view, both figures magnified two diameters.

CYATHOCRINUS BLAIRI, M. & G. 50

Fig. 21. Azygous view.
Fig. 22. Summit.

THYSANOCRINUS MILLIGANÆ, n. sp 51

Fig. 23. Basal view.
Fig. 24. Azygous view.
Fig. 25. Opposite side view.

POTERIOCRINUS PULASKIENSIS, n. sp 39

Fig. 26. Azygous view.
Fig. 27. Opposite side of the same.

LECANOCRINUS GREENEI, n. sp 52

Fig. 28. Azygous side view of calyx and part of arms.

SYNBATHOCRINUS ILLINOISENSIS, n. sp 53

Fig. 29. Basal view.
Fig. 30. Azygous view.
Fig. 31. Summit.

FORBESOCRINUS WASHINGTONENSIS, n. sp 54

Fig. 32. Azygous side view.
Fig. 33. Opposite side view.

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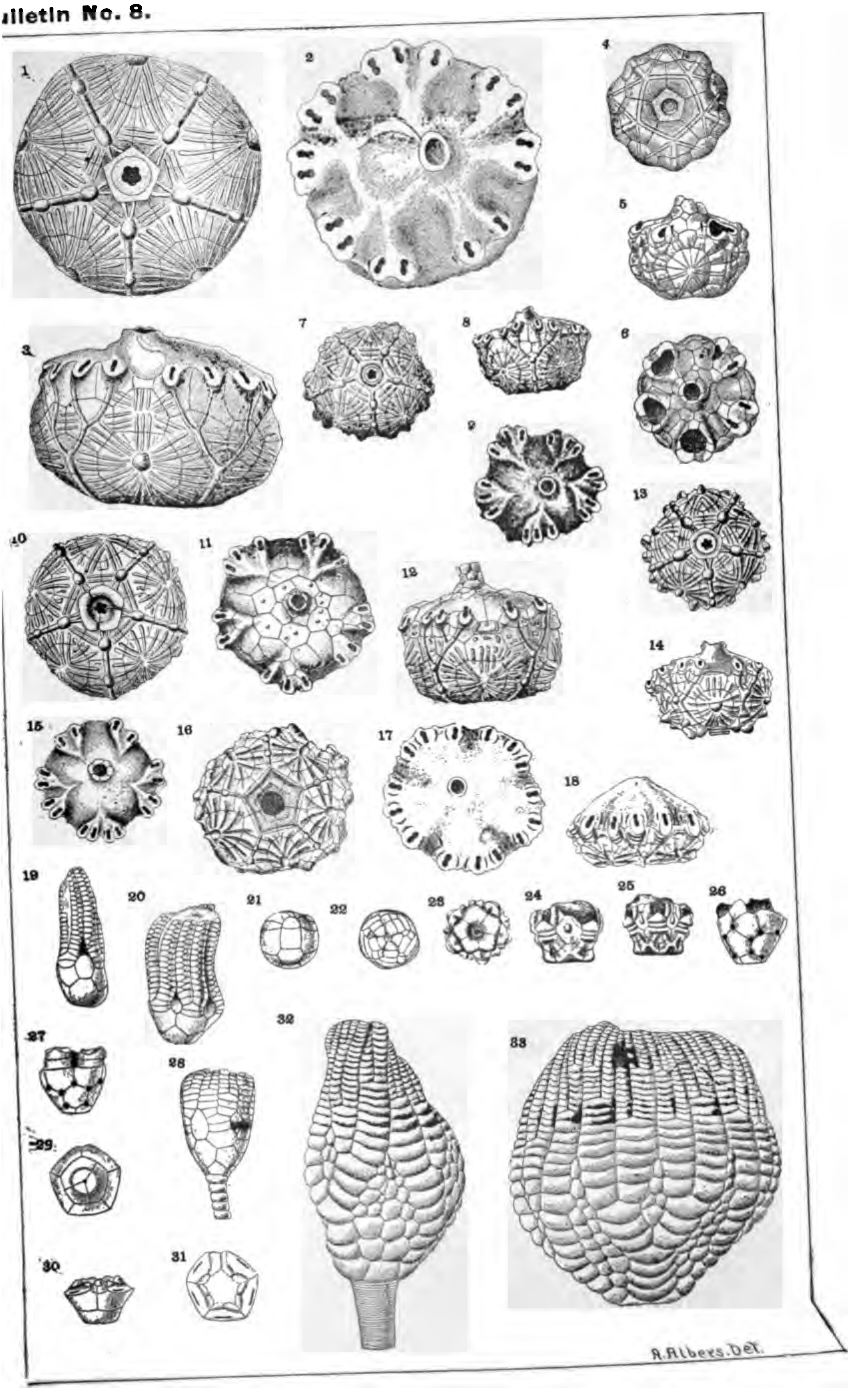
Plate III.



A. Albers. Del.

PLATE IV.

Page.

Forbesocrinus multibrachiatus, L. & C. 55

Fig. 1. Diagrammatic view, copied from Sidney S. Lyon's original drawing, by his son, Victor W. Lyon.

Forbesocrinus jerseyensis, n. sp. 56

Fig. 2. Azygous side view.

Fig. 3. Opposite side view.

Plate IV.

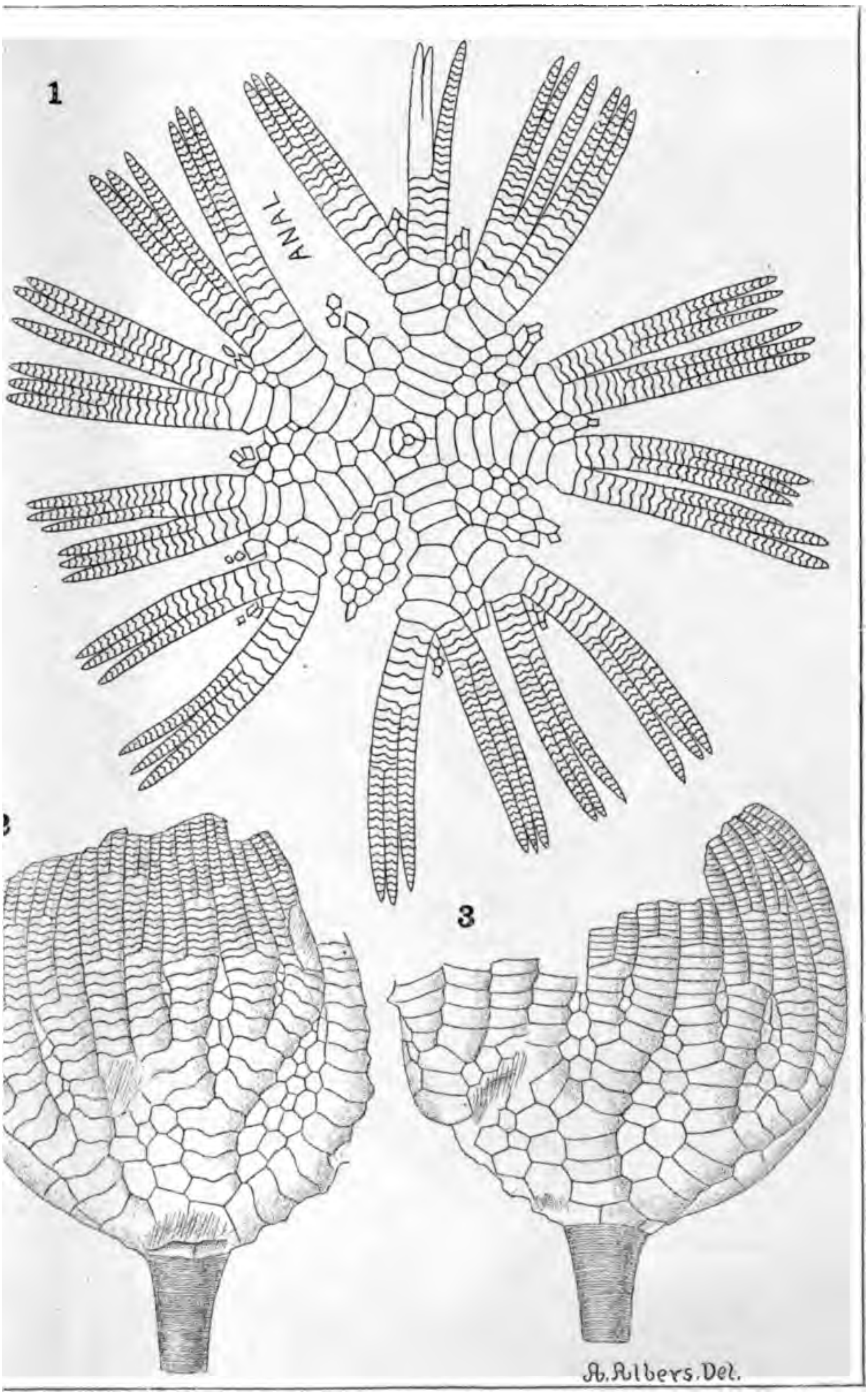
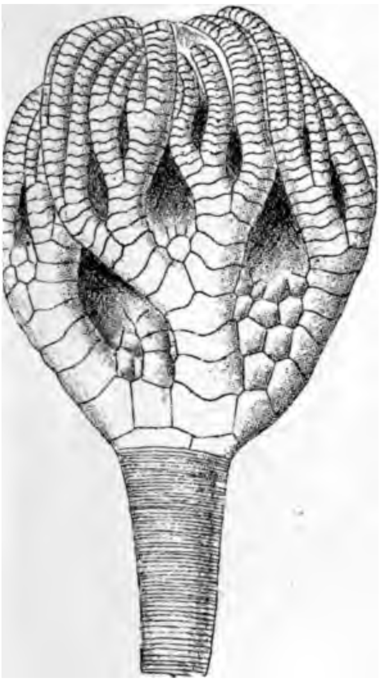


PLATE V.

	Page.
TAXOCRINUS UNGULA, n. sp.	59
Fig. 1. Azygous side view.	
Fig. 2. Opposite side view.	
TAXOCRINUS SPLENDENS, n. sp.	61
Fig. 3. Azygous side view.	
Fig. 4. Opposite side view.	
PLATYCRINUS ILLINOISENSIS, n. sp.	62
Fig. 5. Basal view.	
Fig. 6. Lateral view.	
Fig. 7. Summit.	
PLATYCRINUS HODGSONI, n. sp.	63
Fig. 8. Basal view.	
Fig. 9. Lateral view, azygous area on the left.	



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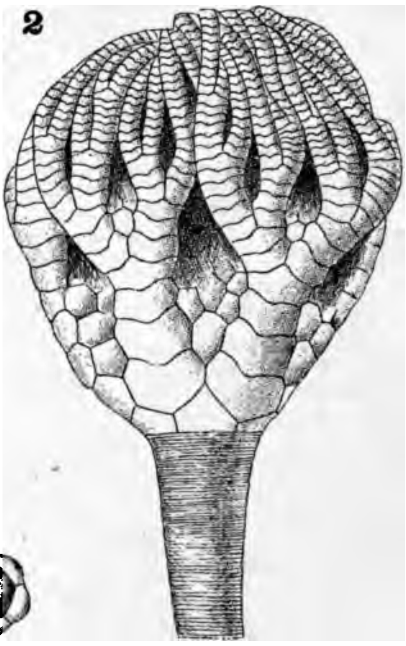

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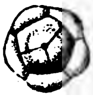

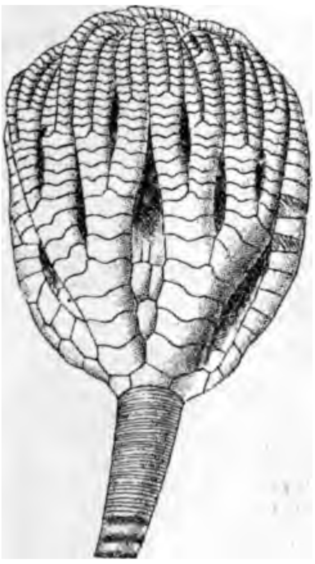

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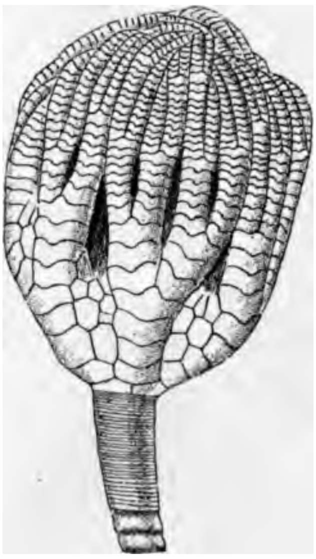

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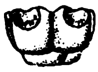

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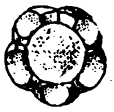

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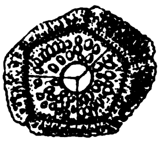

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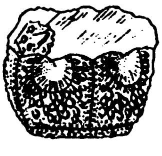

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JC Branner

BULLETIN NO. 9

OF THE

ILLINOIS STATE MUSEUM

OF

NATURAL HISTORY.

NEW SPECIES OF CRINOIDS FROM ILLINOIS AND OTHER STATES.

BY S. A. MILLER AND WM. F. E. GURLEY.

Published quarterly by the Illinois State Museum of Natural History.
SPRINGFIELD, ILLINOIS.
APRIL 20, 1896.

Entered as second class matter at the Postoffice at Springfield, Ill.

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PLATE V.

Page.

Taxocrinus ungula, n. sp. 59

Fig. 1. Azygous side view.

Fig. 2. Opposite side view.

Taxocrinus splendens, n. sp 61

Fig. 3. Azygous side view.

Fig. 4. Opposite side view.

Platycrinus illinoisensis, n. sp. 62

Fig. 5. Basal view.

Fig. 6. Lateral view.

Fig. 7. Summit.

Platycrinus hodgsoni, n. sp. 63

Fig. 8. Basal view.

Fig. 9. Lateral view, azygous area on the left.

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SPRINGFIELD, ILLINOIS.

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WILLIAM F. E. GURLEY,
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NEW SPECIES OF CRINOIDS FROM ILLINOIS AND OTHER STATES.

BY S. A. MILLER AND WM. F. E. GURLEY.

SUBKINGDOM ECHINODERMATA.

CLASS CRINOIDEA.

ORDER PALÆOCRINOIDEA.

FAMILY ACTINOCRINIDÆ.

BATOCRINUS NODOSUS, n. sp.

Plate I, Fig. 1, azygous side; Fig. 2, opposite view; Fig. 3, summit view.

Body rather above medium size, calyx obconoidal, broadly truncated below, about one-third wider than high; arm openings directed nearly horizontally. Plates very tumid, the larger ones subspinous; surface finely granular.

Basals form an hexagonal disc with slight re-entering angles. The plates are very thick and the cavity for the attachment of the column deep. First radials a little wider than long, three hexagonal, two heptagonal. Second primary radials quite small, quadrangular and from two to three times as wide as high. Third primary radials more than twice as large as the second, rather long, pentagonal, axillary, and bear upon each superior sloping side two secondary radials. The second secondary radials are axillary, and in three of the rays, bear upon each superior sloping side the tertiary radials. In some rays there are two tertiary radials and in others only a single long tertiary radial, which gives to each of these rays four arms. The distal side of each ray, adjoining the azygous area, is constructed in this same way, but the proximal side of each bears

an axillary, tertiary radial that supports upon one side a single quaternary plate, and upon the other two quaternary plates, which arrangement gives to each of these rays five arms. There are, therefore, twenty-two arms in this species.

In two of the regular interradial areas there is only a single large plate, in each of the other areas there are two plates, one large, the other quite small. The azygous area contains four large plates and two very small ones. The first one is in line with the first primary radials and rather longer than either of them. It is followed by three large plates, subequal in size, in the second range, and above these, on the left of the central plate, there are two small plates. The azygous area is entirely cut off from the plates of the vault by the union of the quaternary radials.

The vault is moderately convex and covered with polygonal, highly convex, and nodose plates and bears a large subcentral proboscis.

This species is distinguished by its general form, twenty-two arms, nodose and subspinous plates and interradial areas. Heretofore, there have been described, from the Burlington Group, ten species, having twenty-two arms, and probably *B. proximus* is as nearly related to this as any other species though the calyx is much shorter and the radials differently formed, and yet there are more regular and azygous plates in the several areas than in this species. The two species cannot be confounded by any one capable of understanding the structure of crinoids.

Found by C. S. Hodgson, in the Burlington Group, in Adams county, Illinois. and now in the collection of S. A. Miller.

BATOCRINUS NODULOSUS, n. sp.

Plate I, Fig. 4, basal view; Fig. 5, azygous side of calyx; Fig. 6, opposite view of calyx.

Body medium or above medium size. Calyx broadly truncated below, obconoidal, twice as wide as high, arm openings directed upward at a slight angle. Plates spinous. The hexagonal second primary radials, two plates in the second range, in the azygous area, and the sculpturing bring this species near *Actinocrinus*. The interradial areas, are, however, cut off from the vault, and the hexagonal second primary radials are due rather to the number of interradials than to the usual lengthening of the calyx, which induce us to refer the species to *Batocrinus.*

The basal plates form a thin hexagonal disc with slight reentering angles. The disc is only gently concave for the attachment of the column, and the columnar canal is quite large. Each basal plate bears two nodes or short spines that are directed downward. First radial large, wider than long, three hexagonal, two heptagonal, and each one is produced in the form of a wedge-shaped spine. The second primary radials, differ somewhat in size, about one-half wider than long, hexagonal, by reason of a slight truncation of the superior angles by the interradials, and each one bears a central node. Third primary radials smaller than the second, pentagonal, axillary, each bears a central node and supports upon each upper sloping side a single secondary radial, which is axillary and supports, in four of the rays, upon each upper sloping side, a single tertiary radial, which gives to each of these rays four arms. In one of the lateral rays, the third primary radial supports, upon one side, an elongated secondary radial, with a deeply concave facet for the reception of the first arm plate, and upon the other an axillary secondary radial, which supports upon each upper side a single tertiary radial, which arrangement gives to this ray three arms. There are, therefore, nineteen arms in this species.

In one of the regular interradial areas there are five plates, one in the first range, two in the second range, and two in the third range. In each of the other three regular interradial areas there are four plates, one in the first range, two in the second range, and one in the third range. In the azygous area there are seven plates, the first one is in line with the first primary radials and fully as large and spinous as either of them. It is followed by two large spinous plates in the second range, three smaller plates in the third range, and one small depressed plate in the fourth range, that sends an angle high between the tertiary radials and reaches an angle, in a plate, that connects with the vault plates above the summit of the tertiary radials. The last plate mentioned is in part a plate belonging to the calyx, but its superior faces are higher than the ambulacral furrous and unite with plates belonging to the vault. The vault is unknown.

This is a peculiar species that will, at once, be distinguished, by the spinous plates, nineteen arms, and numerous interradials.

Found by C. S. Hodgson in the Burlington Group, in Adams county, Illinois, and now in the collection of S. A. Miller.

BATOCRINUS SALEMENSIS, n. sp.

Plate I, Fig. 10, basal view; Fig. 11, summit: Fig. 12, azygous side.

Species small, vault and calyx subequal, depressed, biturbinate. Calyx saucer-shaped, between two and three times as wide as high. Plates convex, radial series somewhat angular. Ambulacral openings directed horizontally.

Basal plates form an hexagonal disc one-half wider than the diameter of the column and having a height equal to about one-fourth the diameter of the column. The depression for the attachment of the column is hemispherical. The first primary radials are between two and three times as wide as long, three hexagonal, two heptagonal. Second primary radials quadrangular, short, from three to five times as wide as long. Third primary radials only a little larger than the second, from three to four times as wide as long, pentagonal, axillary, and, in four of the rays, bear upon each upper sloping side two secondary radials the last ones of which are axillary and bear upon each upper sloping side two tertiary, which gives to each of these rays four arms. In the ray opposite the azygous area, the third primary radial bears upon each upper sloping side three secondary radials, which gives to it two arms. There are, therefore, eighteen arms, in this species, and eighteen ambulacral openings to the vault.

In each of two of the regular interradial areas there are three plates, one large followed by two small plates. In each of the other two areas there are only two plates, one large plate followed by one plate in the second range In the azygous area there are six plates. The first one is in line with the first primary radials and nearly as large, it is followed in the second range by three plates, above which there are two plates. One is above the middle plate and the other is to the right of it.

The vault is moderately convex, covered with polygonal spinous plates, and bears a subcentral proboscis. No ovarian pores have been discovered.

This species is distinguished among the eighteen armed species, by its general form, surface ornamentation, two secondary radials, and by the interradial and azygous areas.

It was found in the Warsaw Group, at Salem, Indiana, and is now in the collection of Charles L. Faber.

BATOCRINUS STELLIFORMUIS, n. sp.

Plate I, Fig. 13, basal view; Fig. 14, azygous side; Fig. 15, summit.

Species below medium size, depressed, biturbinate. Calyx broadly rounded below, about three times as wide as high. Radial ridges slightly defined and each series projecting so as to give it a stellate outline. Ambulacral openings directed upward and not visible from a basal view. Plates plane and smooth.

Basal plates form a low cup, hexagonal, with a slight reentering angle on the azygous side. diameter one-half greater than the diameter of the column. Depression for the attachment of the column, moderately concave. First primary radials large, a little wider than long, three hexagonal, two heptagonal. Second primary radials short, quadrangular, three or four times as wide as long. Third primary radials about one-half larger than the second, three times as wide as long, pentagonal, axillary, and, in four rays, bear upon each upper sloping side two secondary radials, the last ones of which are axillary and bear upon each upper sloping side two tertiary radials, which gives to each of these rays four arms. In the ray opposite the azygous area, the third primary radial bears upon each upper sloping side three secondary radials, which gives to it two arms. There are, therefore, eighteen arms in this species, and eighteen ambulacral openings to the vault.

All of the interradial areas connect with the vault. There are four plates in each regular interradial area, one in the first range, two in the second, and one in the third, which separates the radial series and unites with the plates of the vault. There are fourteen plates in the azygous area. The first one is in line with the first primary radials and of about the same size; it is followed by three plates in the second range, six plates in the third range, and four in the fourth range, two of which unite with the plates of the vault. One of the four plates, in the last range. is to the left and another is intercalated between the lower part of the two larger plates that unite with the plates of the vault.

The vault is depressed, convex and covered with small, convex, polygonal plates and has a subcentral azygous orifice slightly elevated above the greatest convexity of the vault, but it could hardly be regarded as a proboscis. No ovarian pores can be discovered.

This is a very peculiar species and so different from all other eighteen-armed species that no comparison with any of them is necessary.

Found by F. A. Sampson, in the Keokuk Group, at Boonville, Missouri, and now in his collection.

BATOCRINUS SIGNATUS, n. sp.

Plate I, Fig. 16, azygous side; Fig. 17, opposite view.

Species medium or below medium size, biturbinate. Calyx broadly truncated, obpyramidal, about twice as wide as high. Radial ridges angular and well defined. Interradial areas flattened. Ambulacral openings directed a little above a horizontal line.

Basals form an hexagonal disc that is expanded in rim around the base of the calyx. Diameter a little greater than the diameter of the column, and height about equal to the thickness of the plates. Shallow concave depression for the attachment of the column. First primary radials a little wider than long, longitudinally angular in the middle part, three hexagonal, two heptagonal. Second primary radials short, quadrangular, three or four times as wide as long. Third primary radials one-half larger than the second, more than twice as wide as long, pentagonal, axillary, and in the ray on the left of the azygous area, and in each lateral ray, bear upon each superior sloping side two secondary radials, the last ones of which are axillary and support on each upper side two tertiary radials, which gives to each of these rays four arms. In the ray on the right of the azygous area there are three secondary radials on the distal side, and two on the proximal side, the last one being axillary and supporting on one upper side a single tertiary radial and on the other two tertiary radials, which gives to this ray three arms. In the ray opposite the azygous area, the third primary radial bears upon each upper side three secondary radials which gives to this ray two arms. There are, therefore, seventeen arms and seventeen ambulacral openings to the vault in this species.

All of the interradial areas connect with the vault and are depressed between the rays. In each regular interradial area there are four plates. The first one is large, it is followed by two plates, in the second range, and by one elongated plate, in the third range, that unites with the plates of the vault. In the azygous area there are eleven plates. The first one is in line with the first primary radials and about as large. It is followed by three plates in the second range. three in the third range, two in the fourth range, and two in the fifth range that unite with the plates of the vault.

Vault conoidal and covered with small, polygonal, convex plates and bearing a very small subcentral proboscis. No ovarian pores have been detected.

This is a marked species so different from all other seventeen-armed species that occur in rocks of the same age that no comparison with any of them is necessary.

Found by N. K. Burkett in the Keokuk Group, at Keokuk, Iowa, and now in the collection of Wm. F. E. Gurley.

BATOCRINUS STRENUUS, n. sp.

Plate I, Fig. 18, azygous side; Fig. 19, side view.

Species small but bearing large and vigorous arms, biturbinate. Calyx bowl-shaped, about twice as wide as high. No radial ridges. Plates convex.

Basals form an hexagonal disc more than one-half wider than the diameter of the column. First primary radials very large, about as high as wide, three hexagonal, two heptagonal. Second primary radials quadrangular, from three to four times as wide as long. Third primary radials a little larger than the second, about three times as wide as long, pentagonal, axillary, and in three of the rays bear upon each upper sloping side two secondary radials, which gives to each of these rays two arms. In each ray adjoining the azygous area there are two secondary radials on the distal side of the third primary radial and two on the proximal side, the last being axillary, which gives to each of these two rays three arms. There are, therefore, twelve arms in this species. The arms are very strong and, above the first two or three cuneiform plates, are composed of a double series of interlocking plates as is usual in this genus The arms are subfusiform and slightly flattened at the superior ends.

There is one plate in each of the regular interradial areas. The first azygous plate is in line with the first primary radials and the largest plate in the body. It is followed by three plates in the second range which separate the secondary radials and unite with three plates belonging to the vault.

The vault is conoidal. Proboscis not exposed in our specimen.

This is the second species ever described from the Keokuk Group having twelve arms. The other is *B. prægravis*, to which this one has no resemblance. This species is distinguished by its general form, twelve arms and wide azygous area and cannot be mistaken for any other.

Found in the Keokuk Group, at Boonville, Missouri, and now in the collection of Wm. F. E. Gurley.

BATOCRINUS DELICATULUS, n. sp.

Plate 1, Fig. 20, azygous side of a specimen somewhat compressed magnified two diameters; Fig. 21, opposite side view of same magnified two diameters.

Species very small and delicate, somewhat biturbinate. Calyx obpyramidal, twice as wide as high. Plates convex, more or less angular. Radial ridges well defined, interradials depressed, and all the interradial areas connect with the vault.

Basal plates form an hexagonal disc which is nearly covered with the end of the column. First primary radials large, about as high as wide, three hexagonal, two heptagonal. Second primary radials quadrangular, from three to four times as wide as long. Third primary radials one-half larger than the second, between two and three times as wide as long, pentagonal, axillary, and on the distal side of each one adjoining the azygous area bears a secondary radial that supports a free arm, and on the proximal side two secondary radials, the last ones being axilliary, which arrangement gives to each of these rays three arms. In each of two lateral rays the third primary radial supports two secondary radials, the last ones being axillary, which gives to each of these rays four arms. In the ray opposite the azygous area the free arms arise from each single secondary radial, which gives to this ray two arms. There are, therefore, sixteen arms in this species. The arms are composed of rounded cuneiform plates for about one-fifth part of their length, above which they are composed of a double series of interlocking plates and gradually flatten toward the superior ends.

There is a single regular interradial in each area and it connects with the plates of the vault. The first azygous plate is in line with the first primary radials and fully as large as any of them. It is followed in the second range by three plates and these unite with the plates of the vault.

The vault is convex. Proboscis not exposed in our specimen.

This is the twelfth species described from the Keokuk Group that bears sixteen arms, but it is readily distinguished from each of them by its general form and by the interradial plates and structure of the arms. It is a marked species and though our specimen is small, it is quite distinct and not the young of any described species.

Found in the Keokuk Group, at Boonville, Missouri, and now in the collection of F. A. Sampson, of Sedalia, Mo.

BATOCRINUS REGALIS, n. sp.

Plate I, fig. 22, basal view; Fig. 23, azagous side; Fig. 24, summit.

Species rather above medium size, depressed, biturbinate or somewhat lenticular. Calyx very rapidly spreading from a moderately rounded base, and having a diameter nearly three times as great as the height. Plates convex. No radial ridges. Surface granular. Arm openings directed a little above a horizontal line and not visible in a basal view.

Basals form an hexagonal disc very little larger than the diamater of the column and having an hemispherical depression for the attachment of the column. An angular low ridge surrounds the columnar depression. First primary radials very convex, unequal in size, from one-third to two-thirds wider than long, three hexagonal and two heptagonal. Second primary radials quadrangular, from two to three times as wide as long. Third primary radials very little larger than the second, more than twice as wide as long, pentagonal, axillary and support on each upper sloping side two secondary radials the last of which is axillary, and, in the rays adjoining the azygous area, and, in the left lateral ray, each proximal upper sloping side bears two tertiary radials and each distal side bears a single tertiary radial which is axillary, and supports upon each upper sloping side two quarternary radials, which arrangement gives to each of these three rays six arms. In the right lateral ray one side only bears quaternary radials as in the arms above described, and, on the other side, the last secondary radial supports, on each upper side, two tertiary radials, which gives to this ray five arms. In the ray opposite the azygous area the last secondary plates bear upon each upper side two tertiary radials, which gives to this ray four arms. There are, therefore, in this species, twenty-seven arms and twenty-seven ambulacral openings to the vault.

The interradial areas are cut off from the vault by the union of the quaternary and tertiary radials. In the regular interradial areas there are only two plates, one large plate followed by a much smaller one. In the azygous area there are five plates. The first plate is in line with the first primary radials and of about the same size; it is followed by three plates, in the second range, and above these there is intercalated a single plate which is below the union of the first quaternary plates.

Vault moderately convex and covered with polygonal convex and tumid plates. The proboscis is subcentral, but it is broken away from our specimen.

This is the first *Batocrinus* ever described, having twenty-seven ambulacral openings to the vault, and, consequently, the arm formula alone distinquishes it from all other species. It is peculiar also in its form and azygous plates.

Found by F. A. Sampson in the Burlington Group, at Sedalia, Missouri, and now in his collection.

BATOCRINUS NITEUS, n. sp.

Plate I, Fig. 30, basal view; Fig. 31, azygous side; Fig. 32, opposite view.

Species medium size, biturbinate. Calyx moderately truncated, obconoidal, in the lower part, and rapidly spreading near the arms, which are directed horizontally, and the radial series project beyond the interradial areas so as to give it a stellate outline. No radial ridges. Plates without ornamentation. Sutures distinct.

Basal plates form a low cup, having a height about equal to half the diameter of the base, which is truncated only the size of the column. Depression for the attachment of the column moderately concave. Columnar canal small. First primary radials large, wider than long, three hexagonal, two heptagonal. Second primary radials quadrangular, and about twice as wide as long Third primary radials a little larger than the second, about twice as wide as long, pentagonal, axillary and, in the two rays adjoining the azygous area, bear upon the proximal sides two secondary radials, the last of which are axillary and support upon each superior sloping side two tertiary radials, and bear upon each distal side three secondary radials, which gives to each of these rays three arms. In each lateral ray the third primary radials support on each upper sloping side two secondary radials, the last being axillary and supporting on each superior side two tertiary radials, which gives to each of these rays four arms. The ray opposite the azygous area bears upon each upper side three secondary radials, which gives to it two arms. There are, therefore, sixteen arms in this species. The arm formula is 3+4+2+4+3.

All of the interradial areas connect with the vault. There are five plates in each of two regular interradial areas, one in the first range, two in the second, and two in the third, the longer one of which unites with the plates of the vault. In each of the other two regular interradial areas there are six plates, one in the first range, two in the second and three in the third, one of which connects with the vault in one area and two in the other. In the intersecondary area, in the ray on the right of the azygous area, there is a plate inserted that connects with the plates of the vault. The azygous area is subelliptical in outline, and contains fourteen plates. The first one is in line with the first primary radials and of about the same size, it is followed by three plates in the second range, the middle one of which is much the largest. There are five plates in the third range, and an intercalated plate over the last one, on the left side. There are two small elongated plates in the fourth range by the side of the upper part of the largest plate, in the third range, which gives us three plates in width at this point, all of which unite with two elongated plates that unite with the plates of the vault. The last two plates unite with a first tertiary radial on the left and a second tertiary radial on the right and then extend up over part of the vault.

The vault is convex and covered with numerous convex, polygonal plates and bears a subcentral proboscis. The interradials are depressed toward the margin. There is an ovarian pore on each side of each pair of arms and on each side of each single arm, which gives to this species eighteen ovarian apertures.

There has never been but four sixteen-armed species heretofore described from the Burlington Group, and neither one of them has any resemblance to this species. This species is, therefore, distinguished by its arm formula, general shape, and regular interradial areas and azygous area.

Found in the Burlington Group, at Burlington, Iowa, and now in the collection of Wm. F. E. Gurley.

BATOCRINUS PARILIS, n. sp.

Plate II, Fig. 1, view of an entire specimen; Fig. 2, azygous view of the calyx.

Species medium size, very symmetrical, biturbinate. Calyx obconoidal, about twice as wide as high, truncated only the size of the column. No radial ridges. Surface smooth or very finely granular.

Basals form a low cup one-half wider than the diameter of the column. First primary radials one-third wider than long, three hexagonal, two heptagonal. Second primary radials quadrangular, three times as wide as long. Third primary radials a little larger than the second, pentagonal, axillary and in the ray on each side of the azygous area bear on the distal sides three secondary radials and on the proximal sides two secondary radials, the last of which are axillary and support on one upper side a single tertiary radial and upon the other two tertiary radials, which gives to each of these rays three ambulacral openings to the vault. In each of the lateral rays the third primary radial supports on each upper side two secondary radials, the last being axillary and supporting on each upper side a tertiary radial, which gives to each of these rays four ambulacral openings to the vault. In the ray opposite the azygous area the third primary radial supports on each upper sloping side three secondary radials, which gives to this ray two ambulacral openings to the vault. There are, therefore, sixteen ambulacral openings to the vault in this species. The arms bifurcate on the first plate and hence there are thirty-two arms in this species. The arms are composed of a double series of interlocking plates from the beginning and flatten toward the superior ends and become longitudinally concave, as shown in the illustration.

None of the interradials connect with the plates of the vault. There are three plates in each regular interradial area, one large followed by two smaller ones. There are six plates in the azygous area. The first one is in line with the first primary radials and about the same size. It is followed, in the second range, by three large plates, subequal in size, and these are followed in the third range by two small plates directly over the middle plate in the second range.

The vault is conoidal and about as large as the calyx. It is covered with smooth, polygonal plates and bears a long, small central proboscis.

This species is distinguished by the smooth plates of both the calyx and vault, by the sixteen ambulacral openings, with a formula of 3+4+2+4+3, and thirty-two arms. It is further distinguished by the six plates in the azygous area. Only three species have been, heretofore, described from the Keokuk Group with thirty-two arms, and none of them resemble this one. There have been fifteen species described from the Keokuk Group with sixteen arms and possibly one or two of these have thirty-two arms, but they are ornamented species bearing radial ridges and have little resemblance to this one. It is unnecessary to make any comparison with any other species.

Found in the Keokuk Group, at Boonville, Missouri, and the specimen having the arms with other specimens are in the collection of Wm. F. E. Gurley, and the one showing the vault and others are in the collection of S. A. Miller. It preserves part of the arms opposite to the side illustrated.

REMARKS.—The arms flatten as they approach the superior ends and when they curve in or infold toward the vault they become longitudinally concave in all the specimens. This is another illustration of the futility of undertaking to establish genera on the character of the arms, for if you can do so, this would belong to *Eretmocrinus* or to a new genus, according to the taste of the author.

BATOCRINUS FABERI, n. sp.

Plate II, Fig. 3, azygous side; Fig. 4, opposite view.

Body rather below medium size and somewhat biturbinate or wheel-shaped, though the calyx is decidedly larger than the vault. Calyx truncated below and slowly expanding to the third radials and then abruptly spreading to the free arms. Arm openings directed horizontally. Twice as wide as high. No radial ridges. Plates slightly convex in the superior part and tumid below. Surface granular.

Basals short and form a low subhexagonal disc, with slight re-entering angles. The disc is about one-fourth wider than the diameter of the column and bears a shallow concave depression for the attachment of the column. and a small round columnar canal. First radials a little wider than long, three hexagonal, two heptagonal. Second radials quite small, quadrangular, and three or four times as wide as long. Third primary radials about twice as large as the second, pentagonal, axillary and bear upon each upper sloping side two secondary radials, the last one being axillary, and supporting in some rays a single tertiary radial and in others two tertiary radials, which arrangement gives to each ray four arms. There are, therefore, twenty arms in this species and twenty ambulacral openings to the vault.

There are two plates in each regular interradial area, the first one large and tumid, the second one much smaller. There are five plates in the azygous area. The first one is in line with the first primary radials and rather larger than either of them. It is followed by three plates in the second range, the middle one being the smallest and quadrangular. Above the middle plate there is a smaller and wider plate. The plates in the azygous area look very much like the three primary radials in a radial series, and the first regular interradial on each side of the quadrangular middle plate, as shown in the illustrations. No ovarian pores can be detected.

The vault is convex, without interradial depressions and covered with polygonal convex plates. It bears a subcentral proboscis.

This species is distinguished among those bearing twenty arms, by its general form and by the azygous plates.

It was found in the Burlington Group, in Adams county, Illinois, and is now in the collection of Charles L. Faber.

BATOCRINUS PETTISENSIS, n. sp.

Plate II, Fig. 5, azygous side; Fig. 6, opposite view.

Species medium size, biturbinate, calyx and vault subequal. Calyx rather broadly truncated, obconoidal, most expanded opposite the azygous area, arm openings directed nearly horizontally, but not visible in a basal view. No radial ridges. Plates highly convex or tumid.

Basal plates form an hexagonal disc that bears an hemispherical depression for the attachment of the column, and has a diameter one-half greater than the diameter of the column.

First primary radials wider than long, very tumid, three hexagonal, two heptagonal. Second primary radials small, quadrangular, three or four times as wide as long. Third primary radials twice as large as the second, pentagonal, axillary, and support on each upper sloping side two secondary radials, the last of which are axillary and support on each upper sloping side two tertiary radials, except in the arms adjoining the azygous area where there are three, which arrangement gives to each ray four arms. There are, therefore, twenty arms in this species.

None of the interradial areas connect with the vault. There is a single plate in the regular interradial area, on the right of the azygous area, and two plates in each of the other regular interradial areas, the first one large, the second one smaller. Azygous area subovate and contains eight plates. The first one is in line with the first primary radials and fully as large. It is followed by three plates in the second range, three plates in the third range, and one small plate in the fourth range, which is cut off from the vault by the third tertiary radials.

The vault is convex and covered with tumid polygonal plates, and bears a rather large subcentral proboscis.

This species is distinguished from all other twenty-armed species by the third tertiary radials adjoining the azygous area and by the form of the azygous area and the number of plates it contains. It is unnecessary to carry the comparison further.

Found in the Burlington Group, at Sedalia, Missouri, and now in the collection of F. A. Sampson.

BATOCRINUS SPURIUS, n. sp.

Plate II, Fig. 7, one of the azygous sides; Fig. 8, the other azygous side; Fig. 9, opposite view.

The specimen to which we have attached the name above is medium size, robust, has only four rays, eighteen arms and two azygous areas. If it is abnormal, we are unable to refer it to any described species, and as it is extraordinary and bears no evidence of ever having been injured, we think we are justified in giving it a name and describing it.

It is biturbinate. Plates convex or tumid.

Basals stand upright, and form a cup, about one-half wider than the diameter of the column, having a height equal to about one-third of the diameter, rather deeply notched at the sutures and having a hemispherical depression for the attachment of the column. Columnar canal cinquefoil. First primary radials unequal in size, wider than long, three hexagonal, one heptagonal. Second primary radials four times as wide as long, quadrangular. Third primary radials three or four times as large as the second, pentagonal, axillary, and in two of the rays support on each upper side two secondary radials, the last being axillary and supporting on each upper side two tertiary radials, which gives to each of these rays four arms. In the other two rays, one of which is on the left of an azygous area and the other between the azygous areas, there is on one side of the third radials two secondary radials, the last being axillary and supporting two tertiary radials, and on the other side a secondary radial which is axillary and supports on one side two quaternary radials and upon the other a tertiary radial which is axillary and supports two quaternary radials, which arrangement gives to each of these rays five arms. There are, therefore, eighteen arms in this species.

In each of the two regular areas there are two plates, one large followed by a smaller one. In one azygous area there are six plates and in the other seven. The first is in line with the first primary radials and of about the same size. It is followed, in the second range, by three plates and in the third range by two plates in one area and three in the other.

Vault convex and covered by tumid, polygonal plates and bears a rather large subcentral proboscis.

Found in the Burlington Group, at Burlington, Iowa. and now in the collection of A. Albers, of Cincinnati.

REMARKS.—There have been described one hundred and seventy-seven species of *Batocrinus*, from the Subcarboniferous rocks of North America, and none from rocks higher or lower, in the Geological scale, if we except *Actinocrinus praecursor*, Hall, from the Hamilton Group, which has been referred to *Dorycrinus*, by some authors, and may be a *Batocrinus* or belong to some other genus. It is certainly not an *Actinocrinus*, and we see no reason to think it is a *Dorycrinus*, but the basal and radial series are the same as in *Batocrinus*. Of these one hundred and seventy-seven species, twenty-four have been referred to *Eretmocrinus*, which genus we have elsewhere shown is based upon an association of peculiar specific characters, one or more of which belongs to ordinary *Batocrinus*, and each of which occurs in species undoubtedly referable to *Batocrinus*. Beside, *Eretmocrinus* is only found associated with *Batocrinus*, from the Burlington to the Warsaw Group.

Three species only have been described from the Kinderhook Group or rocks below the Burlington and each of these possessed twenty arms, and only two from the Kaskaskia Group, one of which possessed eighteen and the other twenty arms.

In the Burlington Group they are found with eight, ten, twelve, thirteen, fourteen, fifteen, sixteen, seventeen, eighteen, nineteen, twenty, twenty one, twenty-two, twenty-three, twenty-four, twenty-six and twenty-seven arms. In all the range of arm formulas from eight to twenty-seven only nine, eleven and twenty-five are unknown. The most numerous species possessed eighteen, twenty and twenty-two arms.

In the Keokuk Group they are found with twelve, fourteen, fifteen, sixteen, seventeen, eighteen, nineteen, twenty, twenty-one, twenty-two, twenty-four, twenty-five, twenty-six, twenty-eight, twenty nine, thirty, thirty-two, thirty-three, thirty-six and forty arms. The most numerous species possessed sixteen, seventeen, eighteen, twenty and thirty-two arms. In all the range of arm formulas from twelve to forty only thirteen, twenty-three, twenty-seven, thirty-one, thirty-four, thirty-five and thirty-seven to thirty-nine are unknown.

In the Warsaw and St. Louis Groups they are found with seventeen, eighteen, twenty and forty arms. The most numerous species possessed eighteen and twenty arms.

It will be noticed that while no species has been described from the Burlington Group with twenty-five arms, some have been described with that number in the Keokuk. It must be borne in mind too that some species have been imperfectly described without giving the arm formula, and it may be that the few missing links in the arm formulas, from eight to forty, can or will be supplied. Any one studying these forms must become convinced that the arm formula, in all cases, in this genus, is of specific importance. After having examined many thousand specimens belonging to this genus, we are free to say, that in no case have we found two specimens having a different number of arms, that agreed in other characters, and hence the number of arms, as shown, in the calyx, before the arms became free, must rank in the first degree in determining the specific characters and in entitling the form to a specific name.

As no crinoidal species has ever been known to pass from the Kinderhook to the Burlington, or from the Burlington to the Keokuk, or from the Keokuk to the Warsaw or St. Louis, or from the St. Louis to the Kaskaskia, we have forty-three species above mentioned that may be distinguished by the number of arms alone.

We do not claim to have been original in laying stress upon the arm formula, in determiniing species, in this genus, for Prof. James Hall, in the contributions to the Palaeontology of Iowa, published in 1859, very properly defined the arm formula as of specific importance, in all the *Actinocrinidæ,* he described in that work.

The radial series furnished the characters for the determination of species no less important than the arm formula. In some species the first secondary radials are axillary, and in other species the second secondary radials are axillary. No two specimens possessing these characters can belong to the same species. It will be seen at once that the specimen having two secondary radials will have ten more radial plates within the calyx than the specimen having only one secondary radial, and a further examination will disclose the fact that the interradial areas are correspondingly different and the plates different in number or in size. The first tertiary radials may bear arms or they may be axillary, and the second tertiary radials may bear arms or they may be axillary, but no two specimens can belong to the same species, if they differ in these respects. That is, if one specimen has a single teritary radial and another has two teritary radials they cannot belong to the same species. And, again, while the number of arms in two species may be the same, yet the radial series will be entirely different; for example, one specimen may have three arms in each of four rays and four arms in the other making sixteen arms, and another may have three arms in each of two rays, and four arms in each of two rays, and two arms in the other, making sixteen arms. In such case the two specimens will belong to different species. It will be apparent that the changes, in the latter respect, may be very numerous in specimens having sixteen or more arms, and we find, in fact, that such is the case. It will be seen that these changes alone will provide for more species than have been described. These are therefore, fundamental variations. The general form, however, may be taken into consideration, and the regular and azygous areas dependent thereon as controlling the form, and also the surface ornamentation, especially where it includes the presence or absence of radial ridges, and these particulars may be of specific importance. But to place these species in a family distinct from the *Actinocrinidæ* is without any warrant so far as any learning has extended.

AGARICOCRINUS ADAMSENSIS, n. sp.

Plate I, Fig. 7, azygous side view; Fig. 8, summit view; Fig. 9, basal view.

Species medium or above medium size. Calyx nearly flat, though slightly convex about the basals and first radials. Outline subpentagonal. Plates thick, more or less convex, and part of them subspinous. Arm openings directed rather below a horizontal line.

Basals form an hexagonal disc, very little wider than the diameter of the column, that contains a hemispherical depression for the attachment of the column. Columnar canal quite small. The first primary radials are large, rather wider than long, three hexagonal and two heptagonal. All of them are sculptured so as to be pyramidal or subspinous, the apices extending below the basals, so that a specimen laid upon a table will rest upon these plates and the point of the first azygous plate. Second primary radials short, quadrangular, four or five times as wide as long. Third primary radials about one-half larger than the second, pentagonal, axillary, and in three of the rays support on each upper sloping side two secondary radials, which gives to each of these rays two arms. On the distal side of each third primary radial adjoining the azygous area, there are two secondary radials, and on the proximal side a single secondary radial, which is axillary and supports upon the distal superior sloping side a single tertiary radial, and on the proximal side two tertiary radials which gives to each of these rays three arms. There are, therefore, in this species twelve arms. The last tertiary and secondary radial in each series is thicker and more convex than the adjoining plates, and the ambulacral openings are in part exposed in a basal view.

In one of the regular interradial areas there are only two plates, in each of the other three regular interradial areas there are three plates. The first one rests between the superior sloping sides of the first primary radials and extends up between the first secondary radials. It is followed by one narrow elongated plate in one of the areas and by two narrow elongated plates in the other areas that connect with two plates belonging to the vault. The first azygous plate is in line with the first primary radials, about as large and heptagonal. It is followed by three plates in the second range, which are subequal in size, and each wider than long. In the third range there is a single plate that separates the tertiary radials and extends to the top of the calyx, where it is truncated the full width and unites with a single plate belonging to the vault.

The vault is moderately convex and is covered with large, convex, polygonal plates and a very large heptagonal central plate that supports a long, robust, conical spine. The spine commences to rise at the sutures of the seven adjoining plates. There is no indication of an azygous orifice, but the sutures between some of the plates on the azygous side of the central spine are obscure and possibly the orfice was covered with valvular plates, which have fallen back in place so as to absolutely close it without preserving the sutures. But in any event the orifice must have been very small.

This is a peculiar species, probably more nearly related to *A. hodgsoni* than to any other heretofore described. It does not need any comparison, however, with that species to distinguish it.

Found by C. S. Hodgson in the Burlington Group, in Adams county, Illinois, and now in the collection of S. A. Miller.

ACTINOCRINUS PALLUBRUM, n. sp.

Plate I, Fig. 25, basal view; Fig. 26, summit view; Fig. 27, azygous side.

Species medium size, somewhat lenticular, though the calyx is larger than the vault. Calyx basin-shaped, two and a half times as wide as high. No radial ridges. Plates thick, tumid and sculptured, so as to be more or less pyramidal. Ambulacral openings directed upward and not visible in a basal view.

Basals form an hexagonal disc with slight re-entering angles, having an hemispherical depression for the attachment of the column, and a diameter about one-half more than the diameter of the column. First primary radials rather larger than any other plates, in the body, three hexagonal and two heptagonal. Second primary radials about two-thirds as large as the first and hexagonal. Third primary radials about the size of the second, pentagonal, axillary, and support on each upper sloping side a single secondary radial, about the size of a third primary radial, which is axillary and bears upon each upper sloping side a single tertiary radial, which arrangement gives to this species twenty arms and twenty ambulacral openings to the vault.

All of the interradial and intersecondary radial areas connect with the vault. In the regular interradial areas there is one plate in the first range, two in the second, two in the third, and, in some of the areas, one in the fourth range that connects with the plates of the vault. In other cases there are two plates in the fourth range. There are, therefore, six plates in some of the regular areas, and seven plates in other areas. There is a single plate in each intersecondary radial area, and it connects with the plates of the vault. In the azygous area there are fifteen plates. The first plate is in line with the first primary radials, and nearly as large. It is followed by three plates in the second range and four plates in the third range, one of which extends as high as the top of the fourth range. In the fourth range there are two plates, and two in the fifth range, and two in the sixth range, both of which connect with the plates of the vault.

The vault is only moderately convex, and is covered with numerous small, polygonal plates. The smaller plates are convex and the larger ones subspinous.

The proboscis is small and central. No ovarian pores can be detected in our specimen, and hence it is probable that they opened through the first plates of the free arms.

This species is distinguished by its general form, peculiar vault, interradial, azygous and intersecondary areas. Though eighteen species have been heretofore described from the Burlington Group, bearing twenty arms, none of them have any near affinity with this species.

Found by F. A. Sampson, in the Burlington Group, at Sedalia, Missouri, and now in his collection.

AMPHORACRINUS SAMPSONI, n. sp.

Plate I, Fig. 28, azygous view; Fig. 29, opposite side.

Species varying from medium to large size. We have a specimen one-half larger than the one illustrated. Calyx bowl-shaped, subpentagonal, about as high as wide. Radial ridges distinct and subangular. Interradial areas very wide between the arms, where they unite with the plates of the vault. Plates depressed convex, but none of our specimens preserve the surface ornamentation, if it was ornamented. Column round and small.

Basals form a shallow hexagonal cup, about two and a half times as wide as the diameter of the column, and bearing a slightly concave depression for the attachment of the column. First primary radials are the largest plates in the calyx; they differ somewhat in size, and each one is about as long as wide, three hexagonal and two heptagonal. Second primay radials differ in size from about one-half to three-fourths as large as the first. They are hexagonal and nearly as long as wide. Third primary radials are much smaller than the second, pentagonal, axillary, and support on each superior sloping side two secondary radials, which arrangement gives to this species ten arms.

There are six regular interradials in each area. The first one is as large as a second primary radial. It is followed by two plates in the second range and three in the third, which unite with the plates of the vault. There is a small plate in each intersecondary radial area that unites with the plates of the vault. The plates in the azygous area are numerous, and are not disposed in ranges, but the plates on the sides are longer and larger than those more central. The first plate is in line with the first primary radials, though somewhat smaller. It is followed by three plates in the second range, the middle one being much the smallest. There are five plates in the third range, but the one on each side extends up two ranges higher than the three middle ones do, or there may be said to be as many as ten small plates over the central part of this area before they get as high as the two lateral plates in the third range. The azygous area is very wide in the superior part, and the small plates graduate into those of the vault so that no definite line can be drawn between them. As near as we can judge, however, there should be credited to the calyx, in this area, about forty plates. The two arms in each radial series are close together on each side of the azygous area, while the area is wide, somewhat bulged, and covered with small, irregularly disposed plates.

The vault is unknown. The species is far removed from all heretofore described.

Found by F. A. Sampson, in whose honor we have proposed the specific name, in the Chouteau limestone, at Sedalia, Missouri, and now in his collection.

FAMILY POTERIOCRINIDÆ.

BARYCRINUS NEGLECTUS, n. sp.

Plate II, Fig. 10, azygous view; Fig. 11, opposite view; Fig. 12, side view. Specimen slightly compressed.

Species medium size. Calyx obconoidal. Height nearly equal to the greater diameter. Surface granular. Deep, longitudinal depressions between the subradials, and round, deep pits at the angles between the subradials and radials. Column round.

Basals longer than wide and forming a cup more than one-third the length of the calyx. Subradials longer than wide, by reason of the longitudinal pits, they are contracted in the middle; four hexagonal and one heptagonal. First radials wider than long, deeply pitted at the inferior angles, and truncated about three-fourths of the width above for the first arm plates, or second radials, from which they are separated by a gaping suture. The second radials or first arm plates appear to be attached to the vault but they are followed by two rounded plates and these by an axillary plate. If these four plates are attached to the vault and the arms do not become free until they bifurcate, then this is a very remarkable species. The five radial series bifurcate on the fourth plate above the gaping suture and it is very clear that the arms are then free. Above this part our specimen does not preserve any characters.

The azygous area is also peculiar. The first plate is large and protuberant. It truncates a subradial broadly and slightly truncates another and reaches higher than the adjacent first radials, where it has two superior sloping sides and supports on each a series of rounded plates, that look externally like arm plates but of course they form part of the vault.

This species is distinguished by its form, radial system, and hexagonal first azygous plate. The calyx is like that of a *Poteriocrinus* and the pits and azygous area and plates link it with *Barycrinus*. It can not be mistaken for any other species

Found in the Keokuk Group, at Crawfordsville, Indiana, and now in the collection of Wm. F. E. Gurley.

POTERIOCRINUS ALBERSI, n. sp.

Plate II, Fig. 15, azygous side magnified two diameters; Fig. 16, opposite view, two diameters; Fig. 17, basal view. The specimen is slightly compressed.

Species small; plates covex, angular, rough. Calyx saucer-shaped, about two and a half times as wide as high; plates convex, surface granular.

Basals hidden, or nearly so, by the column. Subradials as long as wide and form with the basals a low cup. First radials one-half wider than long, pentagonal, highly convex toward the superior central part, truncated the entire width above and separated from the second radials by a gaping suture. Second radials about as long as wide, constricted and angular in the middle, axillary and support upon the upper sloping sides the free arms. The arms do not bifurcate. There are, therefore, ten arms in this species. The arms are long and composed of

a single series of long cuneiform plates that alternately project for the support of coarse pinnules. The arms, therefore, have quite a rough aspect.

The azygous plates are alternately arranged. The first one is pentagonal, rests between the superior sides of two subradials and below the first radial on the right and abuts against the second and third plates. The second azygous plate truncates a subradial and abuts the first radial on the left and the first and third azygous plates on the right. The third azygous plate truncates an angle on the first plate and separates the first radial on the right from the second azygous plate. Above these the alternate arrangement is continued as far as the area is exposed in either of our specimens.

This species is distinguished by its saucer-shaped calyx, convex and tumid plates and ten rough arms composed of long cuneiform plates. It is one of the kind that has been referred to *Scaphiocrinus*, on account of the arm structure, but it does not agree with that genus, in the structure of the azygous area, but on the contrary is, in that respect, a *Poteriocrinus* to which genus we refer it. It will not be mistaken for any other species.

Found by the late Wm. McAdams, in the Kaskaskia Group, in Monroe county, Illinois, and now in the collection of Wm F. E. Gurley. The specific name is intended as a compliment to the artist and palæontologist who made the illustrations for this Bulletin.

POTERIOCRINUS LAUTUS, n. sp.

Plate II, Fig. 18, azygous side; Fig. 19, opposite view.

Species medium size. Plates angular, convex, rough. Calyx saucer-shaped, more than three times as wide as high. Surface granular.

Basals hidden or nearly so by the column. Subradials about as long as wide and forming a pentagonal disc very slightly saucer-shaped. First radials twice as wide as long, pentagonal, flattened centrally, truncated the entire width above and separated from the second radials or brachials by a gaping suture. Second radials wider than long, constricted in the middle and in four of the rays axillary, pentagonal and have steep upper sloping sides for the free arms. The arms are composed of cuneiform projecting plates. In the ray on the right of the azygous area the arms bifurcate on the fifth plate and the branch adjoining the azygous area does not bifurcate again, but the next one bifurcates on the ninth plate. The distal ray bifurcates on the seventh plate and the proximal one does not bifurcate. In other words, in this ray, one distal ray bifurcates and the other does not, and one proximal ray bifurcates and the other does not, which is an unusual method. In the other three lateral rays the arms bifurcate on the sixth plate and the distal arms bifurcate on the sixth, seventh and eighth plates and the proximal arms do not bifurcate. This arrangement gives to each of these four rays six arms. In the ray opposite the azygous area the only bifurcation takes place on the fifth plate, which gives to it two arms. There are, therefore, thirty-eight arms in this species.

The first azygous plate rests on the sloping side of a subradial and slightly truncates another below the first radial on the right, and abuts the second and third azygous plates. The second plate truncates a subradial and abuts the first radial on the left and extends above the gaping suture. The third plate truncates the first and extends nearly as high as the first arm plate. Above these the plates are alternate as far as disclosed.

This species is distinguished by its low calyx, thirty-eight arms and rough angular aspect. It is one of the kind that has been referred to *Scaphiocrinus* on account of the rough arms, but it does not agree with that genus, in the structure of the azygous area, but agrees with *Poteriocrinus*, to which genus we refer it. We think it is not a *Zeacrinus* with which it has some affinity. It cannot be mistaken for any other species.

Found in the Keokuk Group, at Boonville, Missouri, and now in the collection of F. A. Sampson.

POTERIOCRINUS NEGLECTUS, n. sp.

Plate IV, Fig. 3, side view, azygous area on the right; Fig. 4, side view, azygous area on the left: Fig. 5, azygous side; the specimen is laterally compressed, as shown by the illustrations.

Species medium or below medium size, constricted above the first radials. Calyx short, cup-shaped. Plates slightly convex; sutures distinct; surface granular. Column quite small.

Basals small but extending beyond the column and forming a low cup that is visible in a side view. Subradials rather large and about as wide as high. First radials a little wider than long, pentagonal, truncated the entire width above and separated from the second radials or brachials by a slightly gaping suture. A single, elongated brachial or second radial, rounded and contracted in the middle, and axillary, in four of the rays, supports upon its upper sloping sides the free arms. In the ray on the right of the azygous area the first brachial or second radial is a subquadrate plate that supports the second brachial or third radial, which is rounded, and axillary, and supports upon its upper sloping sides the free arms. The arms are long, slender, and fit compactly together and are composed of a single series of cuneiform plates. The arms do not bifurcate and there are, therefore, only ten arms in this species. Pinnules are not large and are arranged on the inner part of the arms so as not to prevent the arms from fitting compactly together.

The azygous plates alternate, as is usual in this genus The first plate is the largest, which is an unusual feature, and rests upon the upper sloping sides of two subradials, separates the first radial on the right from the second azygous plate and is truncated above by the third azygous plate. The second plate is somewhat smaller than the first, hexagonal and only slightly truncates a subradial. It abuts upon the first radial and part of the second radial or brachial on the left. Above it the plates alternate and become rapidly smaller.

This species is distinguished by its general form, slender arms, and by having a single brachial in four of the rays and two brachials in the ray on the right of the azygous area. This last feature shows that *Poteriocrinus* cannot be divided into subgenera based on the presence of one or two brachials in the rays.

Found in the Keokuk Group, at Boonville, Missouri, and now in the collection of Wm. F. E. Gurley.

POTERIOCRINUS ARRECTARIUS, n. sp.

Plate IV, Fig. 6, azygous side view, showing part of the proboscis.

Species medium size and not constricted above the calyx. Calyx obconoidal. Sutures distinct. Surface smooth or finely granular.

Basals partly broken away from our specimen, but enough is preserved to show that they form an obconoidal cup. Subradials large and longer than wide. First radials nearly as long as wide, pentagonal, truncated the entire width above, and separated from the second radials or first brachials by a very slightly gaping suture. Second radials or first brachials subquadrate, as long as wide and slightly constricted in the middle. Third radials or second brachials a little shorter than the first, very slightly constricted in the middle, axillary, and support upon the upper sloping sides the free arms. The arms do not bifurcate and there are, therefore, ten arms in this species. The arms are long, slender, and composed of a single series of cuneiform plates that bear small pinnules. The pinnules are from the inside of the arms so as to allow the arms to come together.

The azygous plates alternate, as is usual in this genus. The first plate is the largest and rests upon the upper sloping sides of two subradials, separates the first radial on the right from the second azygous plate and is truncated on top by the third azygous plate. The second plate is somewhat smaller than the first, hexagonal, and only slightly truncates a subradial. The azygous area above these plates is wide and terminates in a wide and long proboscis that, in our specimen, extends beyond the parts of the arms which are preserved and appears to have extended beyond the tips of the arms. The proboscis is fluted and punctured with longitudinal rows of pores between the longitudinal series of plates of which it is composed.

This species is distinguished by its general form, structure of the arms and character of the proboscis.

Found by the late Wm. McAdams in the St. Louis Group, at Alton, Illinois, and now in the collection of Wm. F. E. Gurley.

POTERIOCRINUS LABYRINTHICUS, S. A. Miller.

Plate IV, Fig. 7, azygous view.

[*Cyathocrinus labyrinthicus*, S. A. Miller, 1891. Advance sheets of the 17th report of the Geology and Natural History of Indiana, page 48, and final report, page 659, plate XII, figs. 11 to 14.]

Though several specimens of this species had been collected at the time it was described, none of them fully exposed the azygous area. They showed the azygous plate truncating a large subradial but the folding of the arms around the calyx happened to cover the first azygous plate, which rests between the superior sloping sides of two subradials, and separates the first radial on the right from the second azygous plate and is truncated above by the third azygous plate, which shows that it is a *Poteriocrinus*. The second plate is large and broadly truncates a subradial and was supposed at the time of the description of the species to be the first azygous plate which caused the species to be erroneously referred to *Cyathocrinus*. The position of the first and second azygous plates and the alternate arrangement of the succeeding plates show very clearly that it is a *Poteriocrinus*. Several specimens showing this fact are in the collection of S. A. Miller, but received by him after the species had been described and illustrated. The specimen now illustrated is from the same exposure of the Keokuk Group, at Boonville, Missouri, and is now in the collection of Wm. F. E. Gurley.

SCAPHIOCRINUS NOTATUS, n. sp.

Plate II, Fig. 25, azygous view; Fig. 26, opposite side of same specimen, which is slightly compressed.

The specimen illustrated is compressed so as to appear about one-fifth wider than it really is. The species is above medium size. Calyx short, about twice as wide as high, depressed angular between the first and second radials, so as to give a pentagonal outline.

Column small, round, although broken away from the specimen figured and the small basal plates have been carried away with it, as the angles between the plates shown in fig. 25 indicate. Subradials evidently larger than the basals, four hexagonal and one heptagonal. The lateral sides gradually expand. First radials nearly twice as large as the subradials, about twice as wide as high, pentagonal, truncated the entire width above, convex toward the superior central part, and separated externally from the second radials by a gaping suture. Second radials larger than the first, twice or more than twice as wide as high, longitudinally angular in the central part, pentagonal, and in three of the rays support upon each upper sloping side a robust arm. In the ray adjoining the azygous area, on the right, the distal side of the second radial bears a single arm and the proximal side bears a secondary radial, which is axillary, and supports upon each upper sloping side a free arm; and the ray adjoining the azygous area on the left, bears, on the proximal side of the second radial, a single arm, and on the distal side a secondary radial that is axillary, and supports an arm on each upper sloping side, which arrangement gives to each of these rays three arms, There are, therefore, twelve arms in this species

The arms are robust, and in the lower part composed of quadrangular plates with transverse sutures, which graduate into cuneiform plates in the upward extension of the arms. Each plate supports upon the thicker end a coarse, strong pinnule, and in the middle part a small node, which form a row of nodes on each arm, that gives it a somewhat rough aspect.

There is only one azygous plate. It truncates the larger subradial, separates the first radials but does not extend as high as the second radials, which unite over the top of it. The single azygous plate is, therefore, enclosed within the side of the calyx in the same manner that it is in *Graphiocrinus.*

If this species had no subradials, we would refer it to *Graphiocrinus*, notwithstanding it has twelve arms; but as no species having subradials can be congeneric with one not having them, we have no hesitation in saying, that it is not a *Graphiocrinus*. And here we may say, that after having examined definitions and illustrations of all the species found in this country, that have been referred to *Graphiocrinus*, by different authors, we are fully convinced that the genus has not been found in America.

When Prof. James Hall founded the genus *Scaphiocrinus*, in the Geology of Iowa, Vol. I, p. 551, and described the type, *Scaphiocrinus simplex*, he very clearly distinguished it from

Graphiocrinus. **The species here described is distinguished from *Scaphiocrinus simplex*, by having twelve arms instead of ten, which is a good specific distinction but not of generic importance. It is distinguished again from *S. simplex*, which has six azygous plates or more, that rise above the calyx, by having only one azygous plate confined between the plates of the calyx. This may be of generic importance, but we are not willing to found a new genus upon differences of doubtful importance, when they are known to belong to only a single species. In each case the first azygous plate truncates a subradial and the difference consists, in the additional plates, that separate the second radials and first arm plates, in one species, that do not exist in the other. We prefer, at present, to regard this as of specific importance only. The distinction made by Prof. Hall between *Scaphiocrinus* and *Poleriocrinus* is a good one and all the species he referred to *Scaphiocrinus* properly belong there, as well as some that others have defined. None of them belong to *Graphiocrinus.***

Found in the Kinderhook Group, at LeGrand, Iowa, and now in the collection of Wm. F. E. Gurley.

FAMILY AGASSIZOCRINIDÆ.

AGASSIZOCRINUS OVALIS, n. sp.

Plate II, Fig. 13, an entire specimen viewed opposite to azygous area; Fig. 14, azygous side, of another calyx.

Species large, contracted at the top of the calyx. Calyx somewhat obovoid; surface smooth; sutures distinct. No evidence of a column. Height and greatest diameter subequal.

Basal plates small and forming a low cup with a subacute point below and having upper sutures slightly concave for the reception of the subradials. Subradials longer than wide, showing expanding to the superior lateral angles, and each of them gently rounded. First radials pentagonal, about one-half wider than high, and curving inward, so that the greatest diameter of the calyx is but little above the inferior angle. They are truncated the entire width above and separated from each second radial by a gaping suture. Second radials smaller than the first, curve gently inward and are slightly contracted on the sides. Each one is axillary and supports on each upper sloping side a free arm giving to the species ten arms. The arms are long subfusiform, and composed of a single series of short plates with transverse sutures above the first plate.

Azygous plates three. The first one is subquadrate, except being slightly truncated at one angle by the third plate, it, therefore, has five sides. It is not as large as a first radial and rests between the superior sides of two subradials and below the first radial on the right and supports on its two upper sides the second and third azygous plates. The second azygous plate is smaller than the first, truncates a subradial and abuts a first radial on the left. The third azygous plate is smaller than the second, truncates the first and separates the second from the first radial on the right.

This species is distinguished by its general form, small basals and azygous plates.

Found by the late Wm. McAdams, in the Kaskaskia Group, Randolph county, Illinois, and now in the collection of Wm. F. E. Gurley.

FAMILY RHODOCRINIDÆ.

RHODOCRINUS BLAIRI, n. sp.

Plate II, Fig. 20, basal view; Fig. 21, azygous side; Fig. 22, opposite side; Fig. 23, summit view. Each of these views is magnified two diameters, and they are all taken from the same specimen.

Species small, much below medium size. Calyx bowl-shaped, subpentagonal in transverse section; radial ridges moderately well defined; plates convex. Basal cavity very deep. Column small, canal minute.

Basals form a cone within the calyx, into which the end of the column is inserted. Subradials the largest plates in the body, very convex, as long as wide, one octagonal, the others heptagonal. They are abruptly bent and rounded in the middle, the lower part forming part of the funnel-shaped columnar cavity and the upper part curving as abruptly upward. First primary radials about half or two-thirds as large as the subradials, two hexagonal and three heptagonal. Second primary radials less than one-fourth as large as the first, a little wider than long, quadrangular. Third primary radials about the size of the second, pentagonal, axillary, and support upon each upper sloping side a single secondary radial, which gives to the species ten ambulacral openings to the vault.

The first interradial truncates a subradial in the azygous area, and in three of the regular interradial areas in the other interradial area two plates truncate a subradial, which makes it octagonal, as above stated. The first plate in the azygous area is, however, larger than the first plate in either of the regular areas. In three of the regular interradial areas there are two plates in the second range, and in the other area there are three, and in the third range three plates in two of the areas and two in each of the other two areas. The plates in each of these areas graduate into the plates of the vault, so there is no distinct line of separation between the plates of the calyx and those of the vault. In the azygous area there are three plates in the second range, the middle one of which abuts upon the azygous orifice, which is placed midway between the ambulacral openings at the top of the calyx, where it is surrounded by seven plates.

The vault is slightly convex toward the center and correspondingly depressed in the interradial areas at the margin. It is covered by numerous small, polygonal, convex plates.

This is a very strongly marked species and it is wholly unnecessary to compare it with any other, though it is very clearly a *Rhodocrinus.*

Found by R. A. Blair, in whose honor we have proposed the specific name, in the Chouteau limestone, at Sedalia, Missouri, and now in the collection of S. A. Miller.

FAMILY CYATHOCRINIDÆ.

CYATHOCRINUS CHOUTEAUENSIS, Miller and Gurley.

Plate II, Fig. 24, view opposite the azygous area of a small specimen magnified two diameters.

[*Cyathocrinus chouteauensis*, Miller and Gurley, Bull. No. 7 of Ill St. Mus. p. 68, pl. IV, fig 16, Dec. 5, 1895.]

We have a specimen that we suppose belongs to this species, but it is only about one-fourth as large as the type, and we have illustrated it, because it has a pentagonal column and the column was not preserved in the type. It will be observed that it is magnified two diameters, without being as large as the type, which was illustrated natural size. The arms appear to have been composed of longer plates than those belonging to the type and some other minor differences may be observed, but there is such a striking resemblance between the two, that we think they belong to the same species. If correct the species was quite variable, in size, and possessed a small pentagonal column.

Found by R. A. Blair in the Chouteau limestone, at Sedalia, Missouri, and now in the collection of S. A. Miller.

CYATHOCRINUS BLAIRI, Miller and Gurley.

This species was described and illustrated in Bulletin No. 7 of the Ill. St. Mus. p. 67, pl. IV. figs. 11 to 15, and in Bulletin No. 8 p. 50, pl. III, figs. 21 and 22. Some doubt was expressed as to the generic reference, and, probably, we should have compared it, in the bulletin last mentioned, with ***Mespilocrinus*** of De Koninck and LeHon. But ***Mespilocrinus*** as defined and illustrated has only three basal plates and ***Cyathocrinus blairi*** has five, which must separate them generically. Above the basal plates *Cyathocrinus blairi* substantially agrees with ***Mespilocrinus***, and, if it possessed only three basal plates, we would refer it to *Mespilocrinus*. The general accuracy of De Koninck, in scientific matters, and the fact that we have never found him inaccurate in stating the structure of a crinoid, leaves no doubt in our minds that *Mespilocrinus* has only three basal plates. Two species of *Mespilocrinus* have been described, from the Burlington Group of this country, by Prof. James Hall. They are distinct species and are undoubted *Mespilocrinus*, if he was not mistaken in the number of basal plates, which we have no right to assume. Possibly, the small specimen figured, in Bulletin No. 7, may be distinct from the type of *Cyathocrinus blairi* and if so a new genus may very well be founded for their reception, but the genus would belong to the family *Cyathocrinidæ* and not to the *Ichthyocrinidæ*, where we refer *Lecanocrinus* and *Mespilocrinus*.

FAMILY DOLATOCRINIDÆ.

DOLATOCRINUS DISPAR, n. sp.

Plate II, Fig. 27, side view; Fig. 28, basal view; Fig. 29, summit view.

Species below medium size. Calyx low, somewhat bowl-shaped, gradually expanding from a truncated base to the free arms, without constriction. Radial ridges sharply angular and bear a sharp node, at the middle of each plate. There is also a sharp node on each interradial and a few obscure radiating lines. The primary radials bear no radiating lines. Column round and contains a large cinque foil canal.

Basal disc pentagonal, one fourth wider that the diameter of the column, and contains the concavity into which the end of the column is inserted. First primary radials nearly as long as wide and each one bears a long central node, on the points of which the calyx will rest. Second primary radials wider than long, quadrangular. Third primary radials smaller than the second, pentagonal, axillary, and, in the ray on the right of the azygous area, support on the distal side two secondary radials and on the proximal side a single secondary radial, that is axillary, and supports on each upper side a single tertiary radial, and, in the ray on the left of the azygous area, supports on the proximal side two secondary radials and on the distal side a single secondary radial that is axillary, and supports upon each upper side a single tertiary radial, which gives to each of these rays three arms. In each lateral ray, the third primary radial supports on each upper side a single secondary radial, which is axillary and supports on each upper side a tertiary radial which arrangement gives to each of these two rays four arms. In the ray opposite the azygous area the third primary radial bears upon each upper side two secondary radials which gives to this ray two arms. There are, therefore, sixteen arms in this species. The arm formula is 3+4+2+4+3.

The azygous area is substantially like the other areas. The first interradials are the largest plates in the calyx, have eleven sides, and are followed by three plates in the second range that unite with the plates of the vault.

The vault is only moderately elevated, but the radial ridges are sharply elevated over the ambulacral canals. The azygous orifice is at the top of a central, short elevation. The plates bear small nodes. The sutures between the plates are not distinct in our specimen, and for that reason are not shown in the illustrations. Ovarian apertures small and at the base of the free arms. One on each side of each pair of arms or sixteen in all.

This species is distinguished from all other sixteen-armed species by its general form and surface ornamentation, and also by the plates in the interradial areas, and by the arm formula.

Found by J. F. Hammell in the Hamilton Group, near Charlestown, Indiana, and now in the collection of Wm. F. E. Gurley.

DOLATOCRINUS PRECIOSUS, n. sp.

Plate II, Fig. 30, basal view; Fig. 31, summit view; Fig. 32, view opposite azygous area.

Species above medium size and very handsomely ornamented. Calyx broadly truncated at the base, and constricted below the arms. Radial ridges delicate, with sharp elongated nodes at the central part of the plates. Surface marked by radiating lines of sharp nodes, which are longitudinal, in the upper part of the interradial areas. In some cases the nodes coalesce so as to form lines. The column is round and medium size.

Basal plates form a hollow cone within the cavity of the calyx, which is filled with the end of the column so as to leave a pentagonal disc, at the surface, only a little wider than the diameter of the column. First primary radials nearly as long as wide and subequal in size. Second primary radials large, quadrangular, and about as long as wide. Third primary radials expand to the superior lateral angles. They are larger than the second, pentagonal, axillary, and in the ray on the right of the azygous area and in the left lateral ray, as seen by looking at the vault, bear upon each upper sloping side a single secondary radial, which is axillary and bears upon each upper side two tertiary radials, which gives to each of these rays four arms. In the ray on the left of the azygous area, and in the right lateral ray, the third primary radials bear upon each superior sloping side three secondary radials, which gives to each of these rays two arms. In the ray opposite the azygous area the third primary radial bears upon one upper sloping side a single secondary radial, which is axillary, and supports upon each upper side two tertiary radials, and upon the other three secondary radials, which gives to this ray two arms. There are, therefore, fifteen arms in this species.

The azygous area is very much like the other interradial areas. The first interradials are large and have nine sides and are truncated above by the second interradials. The second interradials are about one-third as large as the first, and are followed in the third range by a somewhat smaller plate that unites with two elongated plates belonging to the vault.

The vault is slightly convex, and correspondingly depressed in the interradial areas toward the margin. It is covered by two circles of plates and a few intercalated ones, the surface of which is beautifully ornamented with coarse granules and delicate nodes. It bears a subcentral azygous orifice slightly elevated above the rest of the vault, and which appears to be about complete in the specimen illustrated. There are small ovarian apertures passing through the plates forming part of the covering of the ambulacral canals near the base of the arms. One on each side of each pair of arms and one on each side of the single arm, which gives to this species sixteen ovarian apertures.

This species most resembles *D. charlestownensis*. In that species the arm formula is 3+4+3+2+3, while in this species it is 4+2+3+4+2. The arms are so arranged in that species that the ray on each side of the azygous area has three arms, while in this, one has two arms and the other four. The proportional size of the plates and the surface ornamentation also differ and there are other minor differences. The arm formulas, however, are sufficient to readily distinguish the species at all times, and such differences are always of specific importance.

Found by Geo. K. Greene in the Hamilton Group, near Charlestown, Indiana, and now in the collection of Wm. F. E. Gurley.

DOLATOCRINUS BASILICUS, n. sp

Plate III. Fig. 1, basal view; Fig. 2, summit view; Fig. 3, side view.

Species large and very much like *Dolatocrinus indianensis*. Calyx subcylindrical, very broadly truncated, and constricted below the ambulacral openings. Radial ridges small, angular, central nodes elongated. Radiating lines from the central part of each plate numerous. Column round and having a large cinque foil columnar canal.

Basal plates form a pentagonal disc about one-third wider than the diameter of the column and having an hemispherical depression for the attachment of the column. First primary radials from one-third to one half wider than long and subequal in size. Second primary radials about one-half wider than long, quadrangular. Third primary radials expand slightly to the superior lateral angles. They are from one-half wider to twice as wide as long, pentagonal, axillary, and, in the rays on each side of the azygous area and in the ray opposite the azygous area bear upon each superior sloping side a single secondary radial, which is axillary and bears upon each upper sloping side two tertiary radials, which gives to each of these rays four arms. In one of the lateral rays the third primary radial bears upon one superior sloping side three secondary radials, and upon the other a single secondary radial, which is axillary and bears upon each upper sloping side two tertiary radials. This ray, therefore, has three arms. In the other lateral ray the third primary radial bears upon each upper sloping side three secondary radials, that give to it two arms. There are, therefore, in this species, seventeen arms and seventeen ambulacral openings to the vault, all of which are directed upward.

The azygous area is substantially like the other areas. The first interradials are the largest plates in the calyx, have nine sides and are broadly truncated above for the second interradials. The second interradials are about half as large as the first, though somewhat unequal in size. The third interradials are less than half as large as the second, and are followed, in one of the areas, by two plates, in the fourth range, that unite with two elongated plates belonging to the vault, and in each of the other areas by a single plate, in the fourth range, that unites with two elongated plates belonging to the vault.

The vault is moderately convex, and covered with a few large polygonal plates. The azygous orifice is subcentral and slightly elevated above the surrounding convexity of the vault, as shown in the illustrations. The specimen is complete, except there may have been small plates that covered the orifice itself. The plates covering the vault are coarsely granular, and those over the junction of the ambulacral canals bear small nodes. There are two elongated plates in each interradial area, and, within these, a circle of seven plates surrounds the base of the elevation for the azygous orifice. There are twenty ovarian pores situated close to the ambulacral openings; one on each side of the double arm openings and one on each side of the single arm openings.

This species is distinguished from *Dolatocrinus indianensis*, which it most resembles, by having one more range of interradial plates in each area, and one more plate in each tertiary radial series, and one more plate in each three secondary radial series. This arrangement lengthens the calyx correspondingly and adds to the radials in the calyx seventeen plates, and to the interradials six plates, as the fourth range, in one of the areas, contains two plates. Other differences in the two species seem to us to be of minor importance, but these, taken together, are of specific value, as we understand the structure of crinoids, in this genus.

Found by Geo. K. Greene, in the Hamilton Group, near Charlestown, Indiana, and now in the collection of Wm. F. E. Gurley.

DOLATOCRINUS LYONI, n. sp.

Plate III, Fig. 4, summit view; Fig. 5, basal view; Fig. 6 azygous side view.

Species medium size. Calyx subhemispherical, broadly truncated and slightly constricted below the arms. Radial ridges small, angular nodes at the center of each plate, sharp and elongated. Surface of each plate ornamented with numerous fine lines radiating from a sharp central node. Column medium size, round and having a very large cinquefoil canal.

Basals form a pentagonal disc, full one-half wider than the diameter of the column, and having an hemispherical depression, for the attachment of the colomn, surrounded by a small rounded rim. First primary radials nearly as long as wide and subequal in size. Second primary radials rather large, quadrangular, and nearly as long as wide. Third primary radials very little, if any, larger than the second, wider than long, pentagonal, axillary and in two of the lateral rays bear upon each upper sloping side three secondary radials which gives to each of these rays two arms. In the ray on each side of the azygous area and in the ray opposite thereto, the third primary radial supports, upon one upper sloping side three secondary radials, and upon the other a single secondary radial that is axillary and supports upon each upper sloping side two tertiary radials, which arrangement gives to each of these rays three arms. There are, therefore, thirteen arms, in this species. In the ray on the left of the azygous area, it is the proximal side of the third primary radial, that bears the three secondary radials, and in the ray on the right it is the distal side that bears the three secondary radials.

The azygous area is substantially like the other interradial areas. The first interradials are the largest plates in the calyx, have nine sides, and are broadly truncated above for the second interradials. The second interradials are about or more than half as large as the first, and are followed by a single plate in the third range full half as large as the second, which unites with two elongated plates belonging to the vault.

The vault is moderately convex, and correspondingly depressed in the interradial areas toward the margin. It is covered with a few rather large plates but the sutures are too indistinct in our specimens for illustration. The plates are granular but most of the granules are eroded, on our specimens, so they are not shown in the illustration. Each plate over the junction of the ambulacral canals bears a strong central node. The azygous orifice is nearly central on the vault and elevated but little above it. There is an ovarian aperture on each side of each pair of arms and on each side of each single arm close to the ambulacral openings which gives to this species sixteen ovarian apertures.

This is the first species of *Dolatocrinus* that has been described having thirteen arm openings to the vault and hence the arm formula alone will distinguish it from all other species.

The specific name is in honor of the late Sydney S. Lyon, who established the genus. Found by Geo. K. Greene, in the Hamilton Group, near Charlestown, Indiana, and now in the collection of Wm. F. E. Gurley.

DOLATOCRINUS CISTULA, n. sp.

Plate III, Fig. 7, basal view; Fig. 8, summit view; Fig. 9, side view.

Species medium size and handsomely sculptured. Calyx subhemispherical, slightly constricted below the arms and broadly truncated at the base. Radial ridges rather large and bearing sharp, elongated nodes. Surface of all the plates bear more or less elongated nodes, and there are a few radiating lines on the first interradials. Column round and having a large cinque foil canal.

Basal plates form a pentagon one fourth wider than the diameter of the column, having an hemispherical depression or cavity for the insertion of the end of the column. First primary radials wider than long, and subequal in size. Second primary radials large, quadrangular and nearly as long as wide. Third primary radials rather larger than the second, pentagonal, axillary, and, in the ray on the right of the azygous area and in the left lateral ray, support on each upper sloping side a single secondary radial, which is axillary and bears upon each upper side two tertiary radials, which gives to each of these rays four arms. In the ray on the left of the azygous area and in the one on the right lateral side the third primary radials support on one upper sloping side three secondary radials, and on the other a single secondary radial that is axillary and bears upon each upper side two tertiary radials, which gives to each of these rays three arms. It is the proximal ray adjoining the azygous area that bears the tertiary radials. In the ray opposite the azygous area the third primary radial supports upon each upper sloping side three secondary radials, which gives to this ray two arms. There are, therefore, sixteen arms in this species. The arm formula is 4+3+2+4+3.

The azygous area is substantially like the others. The first interradials are the largest plates in the calyx. have nine sides and are broadly truncated for the second interradials. The second interradials are more than half as large as the first, and are followed by three plates in the third range, the middle one only abutting upon the third ones, while the lateral ones form part of the covering for the ambulacral channels. The third range unites with two elongated plates belonging to the vault.

The vault is only slightly convex, and is covered with a few large nodose plates. The azygous orifice is at the summit of a short elevation, at the central part of the vault. There are twenty small ovarian apertures.

This species is distinguished from all other sixteen-armed species by its general form and surface ornamentation, and also from all of them by the arm formula. For example, the arm formula in *D. cœlatus* is 4+4+4+2+2, in *D. nodosus* it is 4+3+3+3+3, in *D. salebrosus* it is 4+3+2+3+4, in *D. hammelli* it is 4+3+3+3+3, and in *D. arrosus* it is 4+4+3+3+2.

Found by Geo. K. Greene in the Hamilton Group, near Charlestown, Ind., and now in the collection of Wm. F. E. Gurley.

DOLATOCRINUS ASPER, n. sp.

Plate III; Fig. 10, basal view; Fig. 11, summit view; Fig. 12, azygus side view.

Species medium or rather below medium size. Calyx subhemispherical, broadly truncated. and constricted below the arms. Radial ridges small, sharply angular, and bear a longitudinal sharp node at the middle of each plate. Ridges radiate from a node at the center of each plate. Column round and bears a cinquefoil central canal.

Basal plates form a hollow cone within the cavity of the calyx. The column fills the cone so that the diameter of the column is nearly equal to the diameter of the pentagonal basal disc. First primary radials nearly or quite as long as wide and subequal in size. Second primary radials quadrangular and nearly as long as wide. Third primary radials expand very slightly and are about the size of the second primary radials. They are pentagonal, axillary, and the ray opposite the azygous area bears upon each upper sloping side a single secondary radial which is axillary and bears upon each upper side two tertiary radials which gives to this ray four arms. In one of the lateral rays the third primary radial supports on each upper sloping side two secondary radials which gives to it only two arms. In the rays on each side of the azygous area and in one of the lateral rays the third primary radial supports upon one of its superior lateral sides three secondary radials and upon the other a single secondary radial, which is axillary and supports upon each upper sloping side two tertiary radials, which arrangement gives to each of these three rays three arms. There are, therefore, fifteen arms in this species. In the rays adjoining the azygous area the proximal sides of the the third primary radials support the three secondary plates and each distal side supports the single secondary radial that bears the tertiary series. The arms are composed of a single series of rounded cuneriform plates.

The interradial areas are substantially alike and the azygous area can hardly be distinguished from them. The first interradials are the largest plates in the calyx and have nine sides. They are broadly truncated for the second interradials. The second interradials are not half as large as the first, and each one is followed by a much smaller plate in the third range that united with two plates belonging to the vault.

The vault is quite convex, sharply elevated over the ambulacral canals, and deeply depressed in the interambulacral areas toward the margin. The sutures are partly destroyed in our specimens, so the plates cannot be distinguished, and the surface is more or less eroded and hence these features are not shown in the illustrations. Each plate over the junction of the ambulacral canals bears a strong sharp node. The azygous orifice is somewhat elevated over the central part of the vault. There is a small ovarian aperture close to the ambulacral orifice on each side of each pair of arms and on each side of each single arm, which gives to the species eighteen ovarian apertures.

This species is most nearly related to *Dolatocrinus charlestownensis,* with which it agrees in having fifteen arms. But the arms are not distributed in the same way. In this species the four-armed ray is opposite the azygous area, in that species a three-armed ray is opposite the azygous area and the four-armed ray is lateral. In this species the secondary series and single arm adjoins the azygous area on each side, in that species the secondary series and single arm adjoins the azygous area upon one side and the tertiary radials and double arm on the other. These structural differences must separate the species, though the vaults are also quite different in form and do not agree in the number of the plates, and the surface markings are not the same.

Found by Geo. K. Greene, in the Hamilton Group, near Charlestown, Indiana, and now in the collection of Wm. F. E. Gurley.

DOLATOCRINUS APLATUS, Miller and Gurley.

[*Dolatocrinus aplatus*, Miller and Gurley, Bull. No. 8 Ill. St. Mus. Nat. Hist., p. 48.]

Plate 3, Fig. 13, basal view; Fig. 14, summit view; Fig. 15, side view.

We have illustrated another specimen belonging to this species for the purpose of showing the plates of the vault which are well preserved and the sutures distinct. There are slight differences in the surface ornamentation in the different specimens, but the structural parts of four specimens which we have now before us are the same. All of them are in the collection of Wm. F. E. Gurley.

DOLATOCRINUS ASPRATILIS, n. sp

Plate 3, Fig. 16, basal view; Fig. 17, summit view; Fig. 18 azygous side view

Species rather below medium size. Calyx pentagonal from base to arms, somewhat bowl-shaped, broadly truncated, most expanded in the middle, and constricted below the arms. Columnar cavity pentagonal and deep. Radial ridges angular with long central nodes. Plates pyramidal and radiately sculptured

Basal concavity pentagonal, funnel shaped, and without ornamentation. Basal plates form a hollow cone within the calyx, into which the end of the column is inserted. First primary radials as long as wide and abruptly bent in the middle, the lower part forming part of the funnel-shaped columnar cavity, and the superior end curving as abruptly upward. The plates are pyramidal, with the apex at the center, and radiately sculptured. A furrowed ridge extends from the apex of one plate to the next, which forms the pentagonal outline of the basal concavity and on which the calyx will rest if placed on a level surface. Second primary radials quadrangular, about one-fourth wider than long and sides nearly parallel. Third primary radials smaller than the second, one-half wider than long, pentagonal, axillary, and in four of the rays support on each upper sloping side two secondary radials, which gives to each of these rays two arms. In the ray adjoining the azygous area on the right the third primary radial supports on the proximal side three secondary radials, and on the distal side of a secondary radial that is axillary and supports upon each upper sloping side two tertiary radials which gives to this ray three arms. There are, therefore, eleven arms in this species. The arms are composed, at the base, of a single series of plates.

In the regular interradial areas there are only two plates, but the azygous area is wider in the superior part and contains three plates. The first interradials are large, pyramidal and radiately sculptured. The second plate is quite small, not more than one fourth as large as the first and it connects with two plates belonging to the vault. The first azygous plate is like a regular first interradial and is followed by two plates in the second range that unite with three plates belonging to the vault.

The vault is sharply elevated over the ambulacral canals and deeply depressed in the interambulacral areas. The azygous orifice is elevated at the central or subcentral part of the vault, but can hardly be said to be at the summit of a proboscis. The vault is covered with polygonal plates, which, in our specimens, show no surface ornamentation. The ovarian pores appear to be within the last plates belonging to the calyx, and, therefore, to have opened externally at the first free arm plates. There are probably twelve of them, but only part can be seen in our specimens.

There can be very little utility in comparing this species with *D. approximatus*, the only species heretofore described, having eleven arms, for that species has an elongated calyx, four secondary radials in each series, and four ranges of plates in the interradial areas, with four ovarian pores entering the vault between each of the rays, that are continued in furrows across the last interradial plates. It can be of no service to compare it with any species having a different arm formula, for that alone distinguishes it Probably it most resembles *D. bulbaceus* which has only ten arms.

Found by Geo. K. Greene in the Hamilton Group, near Charlestown, Indiana, and now in the collection of Wm. F. E. Gurley.

DOLATOCRINUS LAGUNCULA, n. sp.

Plate III, Fig. 19, basal view; Fig. 20, side view; Fig. 21, summit view.

This species is founded upon five specimens, a medium one being illustrated, and the largest having a diameter one-fourth greater. Calyx low, expanded at the arms, from three to three and a half times as wide as high and deeply and broadly concave below. Columnar pit funnel-shaped and having within it near the top two pentagonal raised ridges running from a tubercle in the middle of each first radial to the next adjoining. Radial ridges merely sharp elevations crossing the plates and interrupted by sharp nodes at the center of each plate. Surface radiately sculptured. Column round, inserted into the cup formed by the basal plates and having a cinquefoil columnar canal.

Basal plates form a round cup so deeply inserted in the calyx that it rises higher than the calyx and ends in the cavity of the vault. The mouth of the cup is about one-third wider than the diameter of the column. First primary radials about as wide as high, sculptured in the upper part. Second primary radials quadrangular, and about twice as wide as high. Third primary radials expand upward to the lateral angles, longer than the second, pentagonal, axillary and in each of four rays bears upon one upper sloping side four secondary radials and upon the other one secondary radial, which is axillary and bears upon each upper sloping side three tertiary radials, which arrangement gives to each of these rays three arms. In the other ray the third primary radial supports upon each upper sloping side four secondary radials which gives to it two arms. There are therefore, fourteen ambulacral openings to the vault and fourteen arms in this species.

The first regular interradials are nine-sided plates followed in the second range by a smaller plate which in turn is followed by two small plates that unite with the plates of the vault. The azygous area is not materially different from the other areas.

The vault is convex, most tumid on the azygous side, and bears a subcentral proboscis which is longer on one of the specimens than it is on the specimen illustrated. The plates are large and those about the base of the proboscis bear a central tubercle. There are four elongated ovarian apertures between each radial series and between each single ray and the double ray in each series and two between the other rays which gives to the species forty-eight of these apertures.

The surface ornamentation and general form of this species resembles *D. hammelli*, but that species has sixteen arm openings to the vault while this one has only fourteen. which will readily distinguish the species.

Found by J. F. Hammell in the Hamilton Group near Charlestown, Indiana, and now in the collection of Wm. F. E. Gurley.

DOLATOCRINUS ARROSUS, n. sp.

Plate III, Fig. 22, basal view; Fig 23, azygous side; Fig. 24, summit view.

Species medium size and elegantly sculptured. Calyx sub cylindrical, not constricted below the arms, broadly truncated at the base. Radial ridges rather large and bearing prominent nodes in the middle part of each plate. The surface is further ornamented by long sharp nodes at the center of the interradials and by numerous radiating lines from the central nodes of all the plates. Column large and having a large cinquefoil canal.

Basal plates form a pentagon less than one-fourth wider than the diameter of the column and having an hemispherical depression for the insertion of the end of the column. First primary radial a little wider than long, subequal in size, and the calyx will rest on the points of the central nodes in these plates. Second primary radials large, very little wider than long, quadrangular. Third primary radials about the size of the second, pentagonal, axillary, and in two of the rays support on each upper sloping side a single secondary radial which is axillary and supports on each upper sloping side two tertiary radials which gives to each of these rays four arms. These two rays adjoin the azygous area. In each of the lateral rays the third primary radial supports on one upper sloping side three secondary radials, and on the other a single secondary radial which is axillary and supports upon each upper sloping side two tertiary radials, which gives to each of these rays three arms. In the ray opposite the azygous area the third primary radial supports upon each upper sloping side three secondary radials which gives to this ray two arms. There are, therefore, sixteen arms in this species. The arm formula is 4+4+3+3+2.

The interradial areas are substantially alike. The first interradials are the largest plates in the calyx, have nine sides, and are truncated above for the second interradial, which is rather less than half as large as the first. It is followed in the third range by a small plate that unites with two plates belonging to the vault.

The vault is convex, elevated over the ambulacral canals and concave in the interambulacral areas, and bears a short subcentral proboscis, at the summit of which is the azygous orifice. The plates are large, covered with granules, and each one bears a central tubercle except the two elongated plates in concave depression in each interambulacral area. There are two ovarian apertures between each ray, and also between each double ray and the single rays, which arrangement gives to the species twenty ovarian apertures. This species is distinguished by its general form and surface ornamentation from all other sixteen armed species. It is also distinguished from *D. cœlatus* and all species except *D. salebrosus* by the arm formula. The arm formula is like *D. salebrosus*, but that species has a concave depression below, and is constricted below the arms, and has two interradials in the second range, and very different surface ornamentation. This species cannot be mistaken for any other, either upon superficial examination or upon close inspection of the number and arrangement of the plates.

Found by Geo. K. Greene in the Hamilton Group, near Charlestown, Indiana, and now in the collection of Wm. F. E. Gurley.

DOLATOCRINUS DISSIMILARIS, n. sp.

Plate III, Fig. 25, basal view; Fig. 26, summit view, Fig. 27, azygous side view.

Species below medium size, depressed or very short. Calyx low, about three times as wide as high, rounding out from a deep basal cavity and spreading, without any constriction below the arms and having the general form of *D. aplatus*. Surface deeply sculptured. Radial ridges very small and nodes small. The central part of each interradial instead of bearing a node is excavated.

Basal plates within the cavity of the calyx and extend higher than the base of the free arms, funnel-shaped. First primary radials within the funnel-shaped basal cavity and longer than wide. Second primary radials about twice as wide as long, quadrangular. Third primary radials a little larger than the second, twice as wide as long, pentagonal, axillary, and in each ray adjoining the azygous area and in the ray opposite the azygous area support on one of the upper sloping sides three secondary radials and upon the other a single secondary radial, which is axillary and supports on each upper sloping side two tertiary radials, which arrangement gives to each of these rays three arms. In each of the other lateral rays the third primary radials support on each upper side three secondary radials which give to each of these rays two arms. There are, therefore, thirteen arms in this species. It is the proximal side of each ray adjoining the azygous area that bears the tertiary radials.

The azygous area is like the other areas. The first plate is somewhat elongated, has nine sides and is truncated by a single plate, less than one-fourth as large, in the second range. There is one small plate in the third range, that unites with two plates belonging to the vault.

The vault is quite evenly convex, has small ridges over the ambulacral canals and bears a small, short, almost central proboscis. The sutures cannot be distinguished, in our specimen, and the surface is eroded so the ornamentation is not shown, in the illustrations. There are four ovarian apertures to each ray, or twenty in the the species, all of which are elongated and enter the vault instead of the ambulacral canals.

This species in its general form resembles *D. aplatus*, but that species has fifteen arms while this one has thirteen so the arm formula alone will distinguish them. The only species with which this one agrees, in the arm formula, is *D. lyoni* above described but the species are readily distinguished by the general form and surface ornamentation as well as by the interradials. It is not necessary to make any comparison with any other species.

Found by J. F. Hammell in the Hamilton Group, near Charlestown, Indiana, and now in the collection of Wm. F. E. Gurley.

DOLATOCRINUS PECULIARIS, n. sp.

Plate III, Fig, 28, azygous side; Fig. 29, basal view; Fig. 30, summit.

Species above medium size but very short. Calyx broadly and deeply concave below and slightly constricted below the arms. Radial ridges very inconspicuous, and interrupted at the sutures.

The plates are very tumid and radiately furrowed toward the margins. The surface ornamentation resembles that of *D. vasculum* and there is much resemblance in the general form of the two species, but that is an eighteen-armed species and this is a seventeen-armed one. Column small but having a comparatively large cinquefoil canal.

Basals deeply sunken in the concavity so as to extend higher than the base of the arms. The hollow cone thus formed is not entirely filled by the end of the column and the basal disc may be seen having a diameter one-half greater than the diameter of the column. First primary radials as long as wide and entirely within the basal concavity and forming part of the funnel shaped depression. Second primary radials form part of the basal concavity, a little wider than long, quadrangular and the calyx will rest on the central nodes of the first interradials and these plates. Third primary radials curve upward, nearly as long as wide, pentagonal, axillary, and in the ray on each side of the azygous area, bear upon each upper sloping side a single secondary radial which is axillary and bears upon each upper side two tertiary radials, which gives to each of these rays four arms. In each of the other three rays the third primary radial bears upon one upper sloping side three secondary radials, and upon the other one secondary radial, which is axillary and supports upon each upper sloping side two tertiary radials, which gives to each of these three rays three arms. There are, therefore, seventeen arms and seventeen ambulacral openings to the vault in this species. It will be observed that the arm formula is the same that is found in *D. bellulus.*

The interradial areas are not alike, in this species, and the azygous area is smaller than either of three of the others. The first interradials are the largest plates in the calyx, the lower half of each bends into the basal concavity from the middle part and upward at the superior end. In the azygous area and in one of the other areas, it is followed by a single plate, in the second range, about one-fourth as large, and it is followed, in the third range by a smaller plate that unites with the plates of the vault. In the other areas the second interradial is smaller and is followed by two plates in the third range and these are followed by a single plate in the fourth range that unites with the plates of the vault. The plates in the interradial areas thus vary from three to five.

The vault is only moderately convex, depressed in the interambulacral areas, and covered with large tubercular plates. The sutures between the plates are not shown, in the illustrations, because only part of them can be distinguished, in our specimen. The proboscis or short tube for the azygous orifice is excentric, from the azygous side, which is a peculiarity not often observed among the crinoids. There is a large central plate between the tube for the orifice and the azygous area. Notwithstanding these peculiarities, we have no doubt that we are correct in placing the azygous area between the four armed rays. There are four ovarian apertures between each of the rays and two between each of the arms which arrangement gives to the species forty-four ovarian apertures.

This is a remarkable and extraordinary species readily distinguished from all others, though at first glance resembling D. *vasculum* and having the arm formula of *D. bellulus*, 4+3+3+3+4, a species with which it agrees in no other respect. It is not abnormal.

Found by George K. Greene in the Hamilton Group, near Charlestown, Indiana, now in the collection of Wm. F. E. Gurley.

FAMILY TAXOCRINIDÆ.

FORBESOCRINUS GREENEI, n. sp.

Plate IV, Fig. 25, azygous side view; Fig. 2, basal view, showing part of the column broken down.

Species very large; radial series not elevated beyond the interradial areas; plates flattened or slightly convex; sutures beveled. The plates do not overlap, as is usual in this genus, nor does the column taper as rapidly, below the calyx, as usual.

Basals within the calyx. Subradials wide and only partly exposed. Primary radials four in each series and from two to four times as wide as long. They are directed at an angle of about 45 degrees, so as to give the lower side of the calyx a broadly rounded outline, that is continued into the tertiary series of plates where the calyx has its greatest diameter. The last primary radial in each series is longer than those below it, pentagonal, axillary, and has rather steep upper sloping sides upon which it supports the secondary radials. There are three secondary radials in each of eight series and two in the other two series. The proximal series on the left of the azygous area has only two secondary radials and the distal series, in the ray, on the right of the azygous area, has only two secondary radials. The secondary radials, though of unequal size, are not much smaller than the primary radials.

The last ones are axillary and support, on the upper sloping sides, the tertiary radials. The tertiary radials vary in number in the different rays that are preserved, in our specimen, from four to six, but all the series are not preserved, and hence the variation may be greater. There are only a few plates preserved in the quaternary series, so that any definition of them will be of no special service, though the total number of arms is necessarily forty and probably sixty.

The regular interradial areas are of unequal size, more or less elongate-ovate and covered witn large plates. All of the areas are not preserved in our specimen, but in those preserved there are from sixteen to twenty plates. The intersecondary areas are much elongated and have numerous plates. The intertertiary radial areas are also elongated and have three or more plates following each other. In the azygous area an heptagonal plate broadly truncates a subradial. It is followed by two plates in the second range, three in the third, four in the fourth, three in the fifth, three in the sixth, three in the seventh, two in the eighth, two in the ninth, and above these they are not preserved in our specimen, but as these twenty-three plates do not extend as high as the intersecondary or intertertiary plates, it is evident that the total number will be found to be from twenty-seven to thirty.

This species is distinguished by its rounded massive form, transverse or slightly concave beveled sutures, elongated interradial, intersecondary, and intertertiary areas, and by the structure of the azygous area. It will throw no light upon it to contrast it with other species, for it can always be distinguished on the slightest observation.

Found by Geo. K. Greene, in whose honor the specific name is given, in the Keokuk Group, at Edwardsville, Indiana, and now in the collection of Wm F. E. Gurley.

FORBESOCRINUS MACADAMSI, n. sp.

Plate V, Fig. 1, azygous side; Fig. 2, opposite view of the same specimen.

Species very large. Radial series prominent and interradial areas depressed so as to give the calyx a marked quinquelobate outline as seen from below. Plates rounded in the radial series and slightly convex in the interradial spaces. Sutures only moderately concave and slightly beveled. The plates overlap very little, and the column, which is composed of thin plates, tapers slowly from the calyx.

Basals covered by the column. Subradials wide and only partly exposed. Primary radials, five in one of the lateral rays and four in each of the other rays. The first one is longer than either of the others and they vary from two to four times as wide as long. The last primary radial in each series is pentagonal, axillary, and supports the secondary radials. There are four secondary radials in each series in the ray on the right of the azygous area, and three secondary radials in each of the other eight series. The last secondary radial in each series is axillary and supports the tertiary radials. The tertiary radials vary in number in the different rays, as may be seen in the illustrations, from four to nine, and the last one is axillary and supports a quaternary series. Another division takes place in the distal arms in each ray, so as to give to each ray twelve arms. The arms infold at the superior end and some of them again divide, but exactly how many our specimen does not disclose. There are, therefore, more than sixty arms in this species.

The regular interradial areas are of unequal size, long, and lanceolate in outline. In one area there are fourteen plates, in another seventeen, and in another twenty. The intersecondary radial areas are lanceolate and differ very greatly in size. In the one opposite the azygous area there are two elongated plates. In the one on the right of the azygous area there are nineteen plates and in the one on the left of the azygous area there are eight plates. In the intertertiary radial area on the right of the azygous area there are two elongated plates, one following the other, but there are no other intertertiary plates in our specimen. The ray on the right of the azygous area is larger than either of the other rays, more protuberant and contains more intersecondary plates beside the two intertertiary plates. The azygous area is wider and contains more plates than either of the regular areas and is also lanceolate in outline. The first azygous plate broadly truncates a subradial and is followed by two plates in the second range, one of which only truncates it slightly on the left and the other broadly on the right and is followed by a longitudinal series of six or seven plates as disclosed between the arms, and, on the right of this series, and separated from it by a nearly straight suture, there is a longitudinal series of seven plates; on the left and separated by a longitudinal suture there are nine plates in a double series, arranged with some irregularity. There are, therefore, as many as twenty-five or twenty-six plates in this area. It will be seen that if the distinction between *Taxocrinus* and *Forbesocrinus* is dependent upon the azygous area that we have here a *Taxocrinus* by reason of the longitudinal series of plates, and a *Forbesocrinus* by reason of the large area.

This species will be readily distinguished by its quinquelobate form, number of primary and secondary radials and shape of the interradial areas and by the azygous plates.

Found by the late Wm. McAdams, in whose honor the specific name is given, in the Keokuk Group, in Jersey county, Illinois, and now in the collection of Wm. F. E. Gurley.

FAMILY PLATYCRINIDÆ.

PLATYCRINUS FORMOSUS, var., APPROXIMATUS, n. var.

Plate IV, Fig. 8, basal view; Fig. 9, summit view; Fig. 10, azygous side view; Fig. 11, opposite side.

This species or variety is medium size and belongs to the discoid forms. It is so much like *P. formosus* that it can only be called a variety, in the absence of a knowledge of the vault of that species, and, if the vaults are alike then the varietal name may be stricken out, but if the vaults are differently constructed then the varietal name may have the rank of a species. The calyx is shallow, though deeper than in the types of *P. formosus*, pentagonal, three times as wide as high. Plates thick and bearing low rounded nodes less conspicuous than they are in the types of *P. formosus*. Sutures beveled but not canaliculate as they are in *P. formosus*.

Basals form a concave pentagonal disc bordered by a nodose rim. The first radials are rounded upward from the basal suture and constricted in the middle part, beyond which they are directed horizontally, and the facet for the second plate is nearly perpendicular. Each articulating facet forms more than half a circle and has a diameter about one-half the diameter of the plate and is slightly notched for the ambulacral canal.

The angles for the reception of the regular interradials are somewhat acute, and the interradials are longer than wide and stand upright, so as to elevate the vault, and give to the whole body a pentagonal, subglobose outline. The first azygous plate is not as long as the first regular interradials, but a little wider, and bordered at the upper part of each side by an interradial which gives to the azygous area greater width than is found in the other areas, and it is surmounted with two small plates that form part of the rim surrounding the azygous opening.

The vault is abruptly elevated over the calyx so as to retain the pentagonal outline, with concave sides, and so as to have a capacity greater than that of the calyx. It is convex on top and covered with a few large, polygonal, subspinous plates. The largest plate is subcentral on the azygous side and surrounded by nine plates. The azygous orifice is large and situated between the ambulacral openings, though not extending quite so low. It is surrounded by eight plates.

The calyx of this species or variety, as the case, in fact, may be, is not as concave below, as it is in *P. formosus*, and the calyx in that species is four times as wide as high, while, in this, it is only three times as wide as high. The sutures are canaliculate in that species, and beveled in this. The angles of the interradials are more acute in this variety than in that, and appearances indicate that the vault in *P. formosus* is lower than it is in this. If, however, the vaults are alike, this is merely a varietal form of *P. formosus*, unless the difference between the canaliculate and beveled sutures is of specific importance; for the difference in form may exist, in the same species. If, again, this form shall, in future, be referred to *P. formosus*, we are fully justified in publishing it as a varietal form, because we have a complete specimen differing in some respects, from the type, so far as it was preserved.

Found in the Burlington Group, at Sedalia, Missouri, and now in the collection of F. A. Sampson.

PLATYCRINUS SUBSCITULUS, n. sp.

Plate IV, Fig. 12, basal view; Eig. 13, summit view; Eig 14, azygous side; Fig. 15, opposite side.

Species medium or rather below medium size, calyx and vault subequal, in capacity, and it belongs to the discoid forms. Calyx discoid, subpentagonal, about three times as wide as high. Surface without ornamentation, granular, sutures beveled.

Basals form a pentagonal disc with a concave depression toward the central part, where the column attached. The beveled suture surrounding the disc will allow the calyx to rest on the rim of the disc surrounding the concave depression. First radials are directed upward at an angle of about forty-five degrees and are convex toward the facet for the second radials, which is concave and occupies a little more than one-third of the diameter of the plates, and is a little more than half a circle. The second radials are short, constricted, directed horizontally and axillary.

The interradial areas are depressed so as to leave the form pentagonal when seen from above. The interradials are elongated, and instead of rising perpendicularly from the calyx are inclined inward so as to contract the vault in the interradial areas.

Vault elevated over the ambulacral canals and depressed in the ambulacral areas so as to leave only a slight convexity centrally. The plates of the vault are subspinous. A large plate is situated subcentrally on the azygous side and surrounded with seven plates, six of which are subspinous. The azygous orifice is situated between the ambulacral openings, and the first azygous plate is shorter and smaller than the first regular interradials. The orifice is surrounded by eight plates.

This species is distinguished by its general form, freedom from surface ornamentation of the calyx, quinquelobate aspect as seen from above, projecting second radials, and the limited number of plates on the vault.

Found in the Burlington Group, at Sedalia, Missouri, and now in the collection of F. A. Sampson.

PLATYCRINUS CONCINNULUS, n. sp.

Plate IV, Fig. 16, azygous side; Fig. 17, opposite view; Fig. 18, summit view.

Species medium or above medium size. Calyx urn-shaped, rounded below, slightly projecting at the arms so as to give it a subpentagonal outline when seen from above, and about one-fourth wider than high. Surface finely granular. Sutures slightly beveled. Column round.

Basals form a low, rounded cup, pentagonal at the top, and bear a slight constriction or furrow in the middle part above the end of the column. First radials expand slightly and are a little longer than wide. They are convex toward the facets for the second radials. A facet occupies a little more than one-third the diameter of the plate and is semi-circular in outline, and notched for the ambulacral canal. The second radials are very short and axillary, giving ten arms to the species.

The regular interradials are rather large and curve abruptly over on the vault. The azygous interradial stands nearly upright and forms one side of the base of the proboscis.

Vault low, nearly flat, and covered with a few convex and subnodose plates. A highly nodose plate covers the junction of the ambulacral canals at the base of each arm. The base of the proboscis is large and subcentral, but the height is unknown.

The lower part of the calyx of this species resembles *P. concinnus*, but the vaults are altogether different, and that species has eighteen or twenty arms, and this one has only ten. The constriction around the basal plates will distinguish this species from nearly all the urn-shaped species, and none that have been described have a vault similar to this one.

Found in the Burlington Group, at Sedalia, Missouri, and now in the collection of F. A. Sampson.

FAMILY CARYOCRINIDÆ.

CARYOCRINUS MILLIGANÆ, n. sp.

Plate V, Fig. 3, azygous side view; Fig. 4, summit.

Species medium to large size, rapidly spreading to the middle of the second range of plates, where it has an hexagonal outline, then lengthens above and contracts into a comparatively small triangular summit. Ridges radiate from the center of each plate to the angles, except on the basal plates, where the ridges run from the superior angles to the point of columnar attachment. There is a single or double row of pores accompanying these ridges, but none elsewhere on the plates.

The basal plates are of unequal size and form an angular, hexagonal cup rather more than one-fourth the length of the body. The six plates in the second range are of unequal size, two are pentagonal, two hexagonal and two heptagonal. These plates are protuberant at the central part, some of them pyramidal, so that a transverse section at this place is hexagonal. There are eight elongated plates in the third range, of unequal size and different in outline. The general form of six of these plates is pentagonal and the other two quadrangular, but the small plates belonging to the vault change the number of sides so that the subquadrangular plates become hexagonal and the subpentagonal plates become heptagonal, octagonal and nonagonal.

The summit is subtriangular, flat centrally, and the plates turn over the margin in some places and in others stand up over the arm openings so as to hide them from a summit view. The vault is covered with a large central plate surrounded by eight plates and a few small plates around the orifices at the angles of the triangular summit. One of the circle of eight plates abuts against a subquadrangular plate belonging to the third range of body plates at the middle of one side of the triangle and another at the middle of another side, and another against a subpentagonal plate near the middle of the other side and adjoining the mouth. The mouth is a round orifice surrounded by five plates. It is situated near the middle of one of the sides of the triangle, and truncates the angles of two of the third range of body plates, two of the plates belonging to the circle of eight plates on the summit abut upon it, and one plate inserted between the third range and the circle of eight plates abuts against it. The illustration of the azygous side view shows the mouth and the plates surrounding it. The plate on the left is the one intercalated between the range and circle of plates.

The arms are divided into three clusters, which are located at the angles of the summit. There are three arm openings at one of the angles and two at each of the others. The three-armed angle is opposite the mouth. There are, therefore, seven arms in this species. The plate over each arm opening bears a node and there is a small plate between each of the arm openings.

This species is distinguished by its general form from all others. The triangular summit is peculiar and the arrangement of the seven arms at the angles is different from that in any other described species.

Found by Mrs. J. M. Milligan, in whose honor we have proposed the specific name, in the Niagara Group, in Decatur county, Tennessee, and the specimen illustrated is now in her collection. The species is also represented in the collection of each of the authors, though the type is the best preserved and shows the sutures between the plates better than our specimens do.

CARYOCRINUS HAMMELLI, n. sp.

Plate V, Fig. 5, azygous side view, Fig. 6, summit.

Species large, subelliptical in outline, the angular convexity, at the middle of each plate, in the second range, gives an hexagonal outline to the middle part of the body. The summit is irregularly subcircular or suboctagonal. Ridges radiate from the center of each plate to the angles, in the form of coalescing nodes, except on the basal plates, where the ridges run from the superior angles toward the point of columnar attachment. There is a single or a double row of pores accompanying these ridges and there are nodes and pores on other parts of the plates.

Three of the basal plates are about equal in size, but the other one is nearly twice as large as either of them. The large plate is hexagonal in outline, and the others are quadrangular. They form an hexagonal cup about one-third the length of the body. The six plates in the second range are of unequal size, and the larger ones follow the smaller basal plates so that the symmetry of the body is restored; two are pentagonal, two hexagonal, and two heptagonal. They are longer than the plates in either of the other ranges. There are nine plates in

PLATE I.

Page.

BATOCRINUS NODOSUS, n. sp. 5

Fig. 1. Azygous view.
Fig. 2. Opposite side view.
Fig. 3. Summit.

BATOCRINUS NODULOSUS, n. sp. 6

Fig. 4. Basal view.
Fig. 5. Azygous view.
Fig. 6. Opposite side view.

AGARICOCRINUS ADAMSENSIS, n. sp. 24

Fig. 7. Azygous view.
Fig. 8. Summit.
Fig. 9. Basal view.

BATOCRINUS SALEMENSIS, n. sp. 8

Fig. 10. Basal view.
Fig. 11. Summit.
Fig. 12. Azygous view.

BATOCRINUS STELLIFORMIS, n. sp. 9

Fig. 13. Basal view
Fig. 14. Azygous view.
Fig. 15. Summit.

BATOCRINUS SIGNATUS, n. sp. 10

Fig. 16. Azygous view.
Fig. 17. Opposite side view.

BATOCRINUS STRENUUS, n. sp. 11

Fig. 18. Azygous view.
Fig. 19. Opposite side view.

BATOCRINUS DELICATULUS, n. sp. 12

Fig. 20. Azygous side view, magnified two diameters
Fig. 21. Opposite side view of same.

BATOCRINUS REGALIS, n. sp. 14

Fig. 22. Basal view.
Fig. 23. Azygous view.
Fig. 24. Summit.

ACTINOCRINUS PALLUBRUM, n. sp. 26

Fig. 25. Basal view.
Fig. 26. Summit.
Fig. 27. Azygous view.

AMPHORACRINUS SAMPSONI, n. sp. 27

Fig. 28. Azygous view.
Fig. 29. Opposite side view.

BATOCRINUS NITEUS, n. sp. 15

Fig. 30. Basal view.
Fig. 31. Azygous view.
Fig. 32. Opposite side view.

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Plate I.

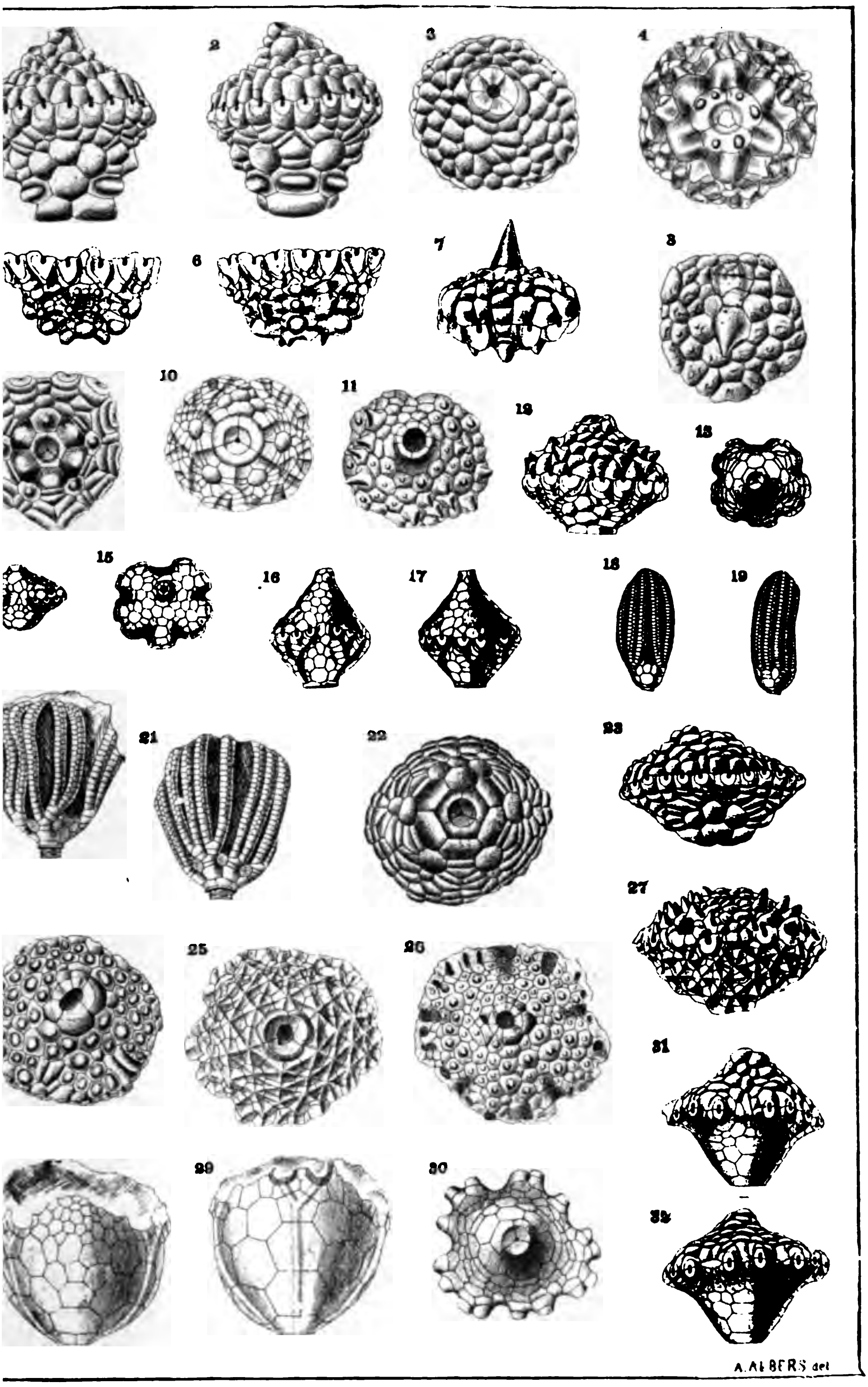

PLATE II.

Page.

BATOCRINUS FACILIS, n. sp 17

Fig. 1. View of calyx and arms.
Fig. 2. Azygous view of calyx.

BATOCRINUS FABERI, n sp 18

Fig. 3. Azygous view.
Fig. 4. Opposite side of same.

BATOCRINUS PETTISENSIS, n. sp 19

Fig. 5. Azygous view.
Fig. 6. Opposite side of same.

BATOCRINUS SPURIOUS, n. sp 20

Fig. 7. One of the azygous areas.
Fig. 8. View of the other azygous area.
Fig. 9. Opposite side of same.

BARYCRINUS NEGLECTUS, n. sp 23

Fig. 10. Azygous view.
Fig. 11. Opposite view of same.
Fig. 12. Lateral view of same.

AGARICOCRINUS OVALIS, n. sp 26

Fig. 13. View of calyx and arms.
Fig. 14. Azygous view of another calyx.

POTERIOCRINUS ALBERSI, n. sp 29

Fig. 15. Azygous view of calyx and arms.
Fig. 16. Opposite side of same.
Fig. 17. Basal view of same, magnified two diameters.

POTERIOCRINUS LAUTUS, n. sp 30

Fig. 18. Azygous view of calyx and arms.
Fig. 19. Opposite side of same.

RHODOCRINUS BLAIRI, n. sp 31

Fig. 20. Basal view of calyx.
Fig. 21. Azygous view of same.
Fig. 22. Opposite side of same.
Fig. 23. Summit. All figures magnified two diameters.

CYATHOCRINUS CHOUTEAUENSIS, M. & G 33

Fig. 24. View opposite azygous side, magnified two diameters.

SCAPHIOCRINUS NOTATUS, n. sp 34

Fig. 25. Azygous view.
Fig. 26. Opposite side of same.

DOLATOCRINUS DISPAR, n. sp 40

Fig. 27. Lateral view.
Fig. 28. Basal view.
Fig. 29. Summit.

DOLATOCRINUS PRECIOSUS, n. sp 41

Fig. 30. Basal view.
Fig. 31. Summit.
Fig. 32. View opposite azygous side.

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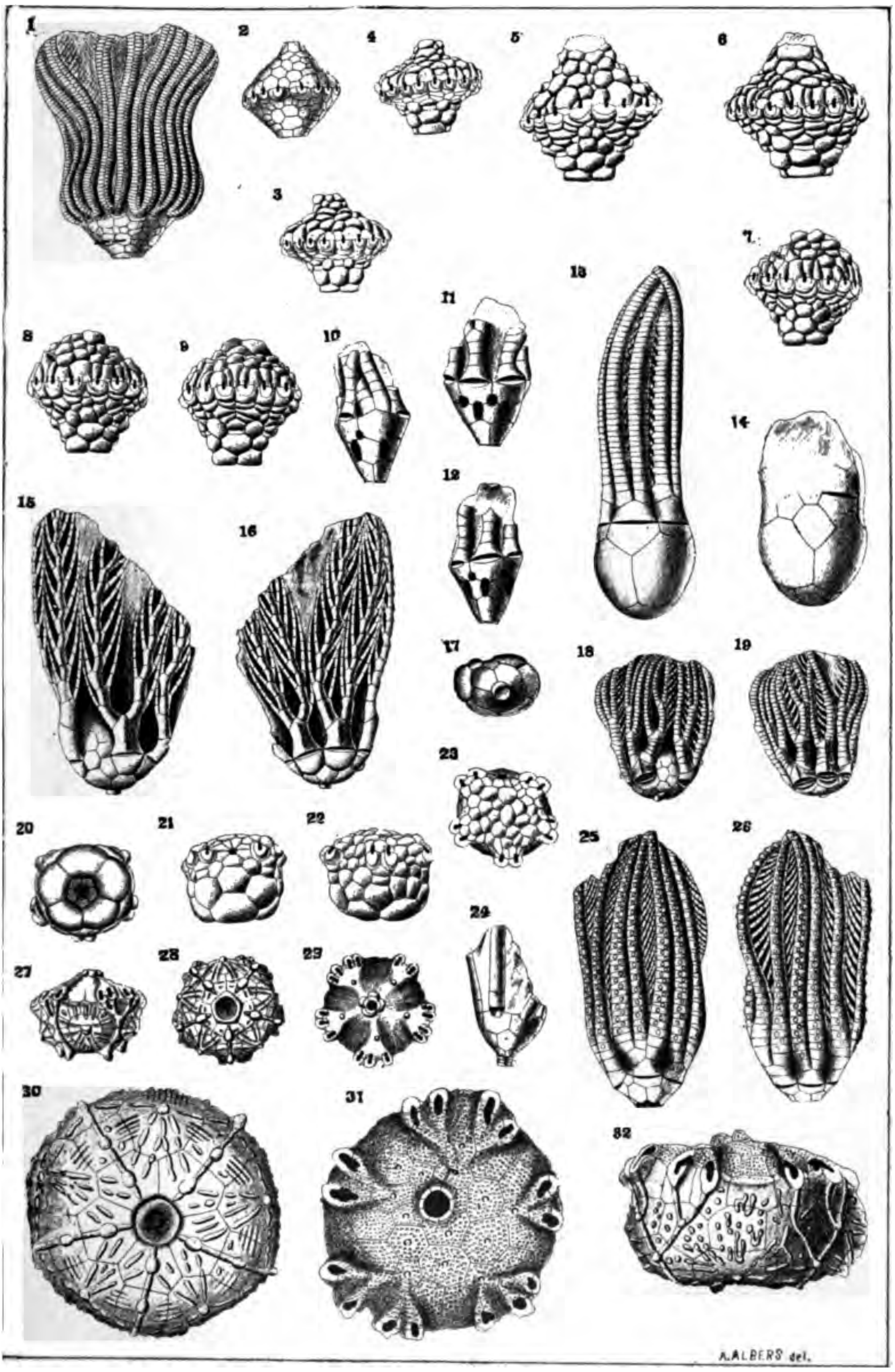

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PLATE III.

Page.

DOLATOCRINUS BASILICUS, n. sp 43

Fig. 1. Basal view.
Fig. 2. Summit.
Fig. 3. Lateral view.

DOLATOCRINUS LYONI, n. sp 44

Fig. 4. Summit.
Fig. 5. Basal view.
Fig. 6. Azygous view.

DOLATOCRINUS CISTULA, n sp 45

Fig. 7. Basal view.
Fig. 8. Summit.
Fig. 9. Lateral view.

DOLATOCRINUS ASPER, n. sp 47

Fig. 10. Basal view.
Fig. 11. Summit.
Fig. 12. Azygous view.

DOLATOCRINUS APLATUS, M. & G 48

Fig. 13. Basal view.
Fig. 14. Summit.
Fig. 15. Lateral view.

DOLATOCRINUS ASPRATILIS, n. sp 49

Fig. 16. Basal view.
Fig. 17. Summit.
Fig. 18. Azygous view.

DOLATOCRINUS LAGUNCULA, n. sp 51

Fig. 19. Basal view.
Fig. 20. Lateral view.
Fig. 21. Summit.

DOLATOCRINUS AEROSUS, n. sp 52

Fig. 22. Basal view.
Fig. 23. Azygous view.
Fig. 24. Summit.

DOLATOCRINUS DISSIMILARIS, n. sp 54

Fig. 25. Basal view.
Fig. 26 Summit.
Fig. 27. Azygous view.

DOLATOCRINUS PECULIARIS, n. sp 55

Fig. 28. Azygous view.
Fig. 29. Basal view.
Fig. 30. Summit.

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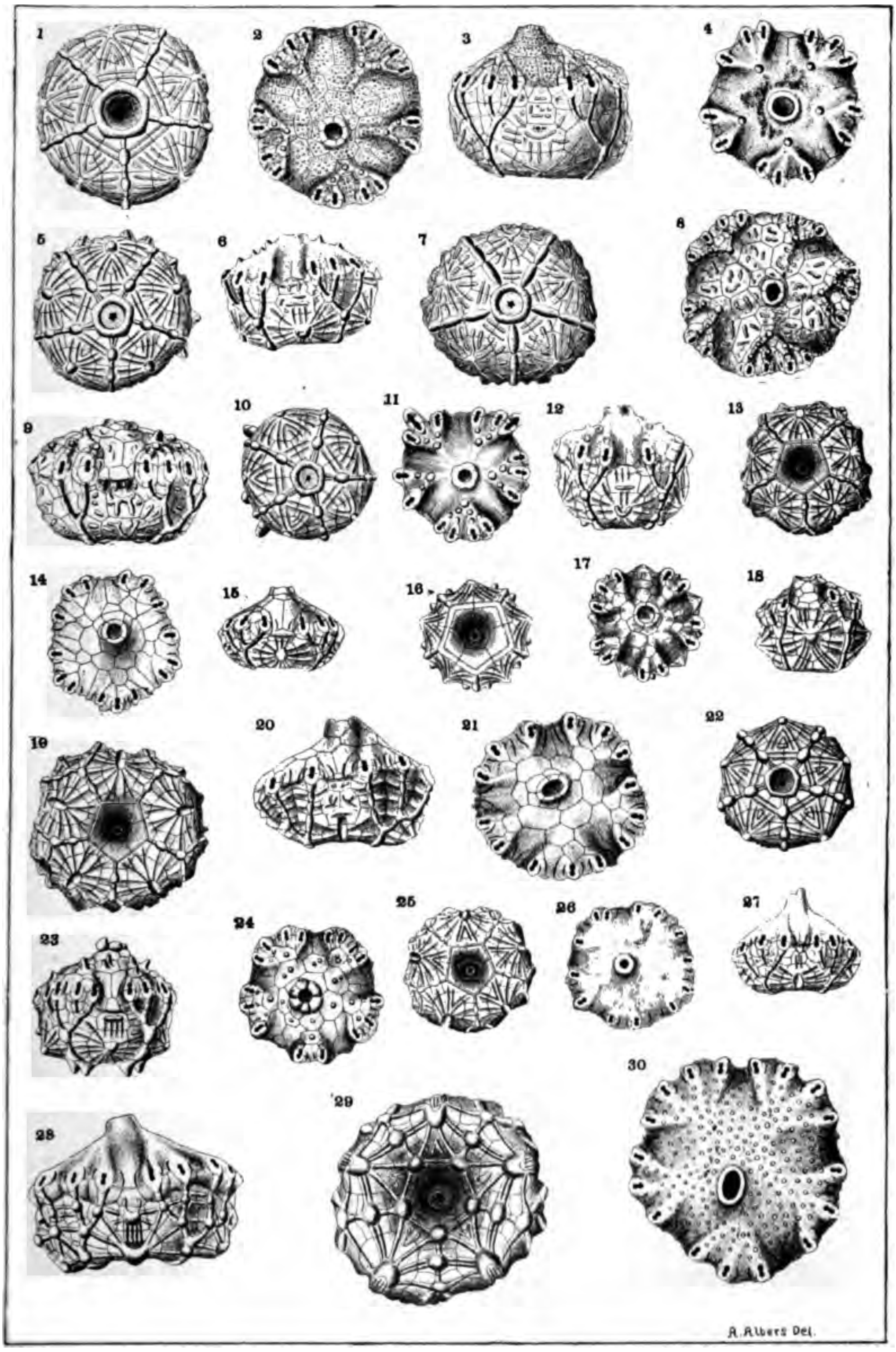

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PLATE IV.

Page.

FORBESIOCRINUS ORRENSIS, n. sp. 57

Fig. 1. Azygous view.
Fig. 2. Basal view.

POTERIOCRINUS NEGLECTUS, n. sp. 58

Fig. 3. Lateral view, azygous area on the right.
Fig. 4. Lateral view, azygous area on the left.
Fig. 5. Azygous view.

POTERIOCRINUS ARRECTARIUS, n. sp. 58

Fig. 6. Azygous view.

POTERIOCRINUS LABYRINTHICUS, S. A. M 59

Fig. 7. Azygous view.

PLATYCRINUS FORMOSUS, var. APPROXIMATUS, n. var. 60

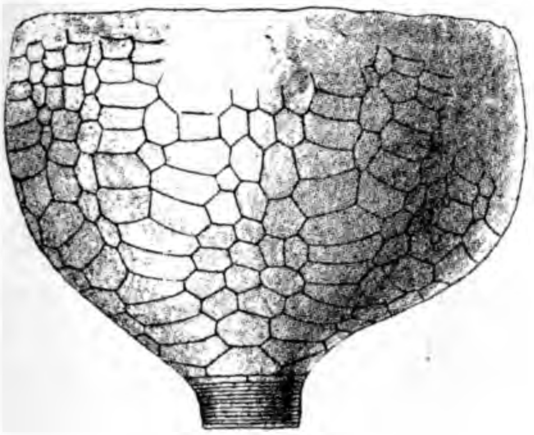
Fig. 8. Basal view.
Fig. 9. Summit.
Fig. 10. Azygous view.
Fig. 11. Opposite side view.

PLATYCRINUS SUBSCITULUS, n. sp 62

Fig. 12. Basal view.
Fig. 13. Summit.
Fig. 14. Azygous view.
Fig. 15. Opposite side view.

PLATYCRINUS CONCINNULUS, n. sp. 63

Fig. 16. Azygous view.
Fig. 17. Opposite side view.
Fig. 18. Summit.



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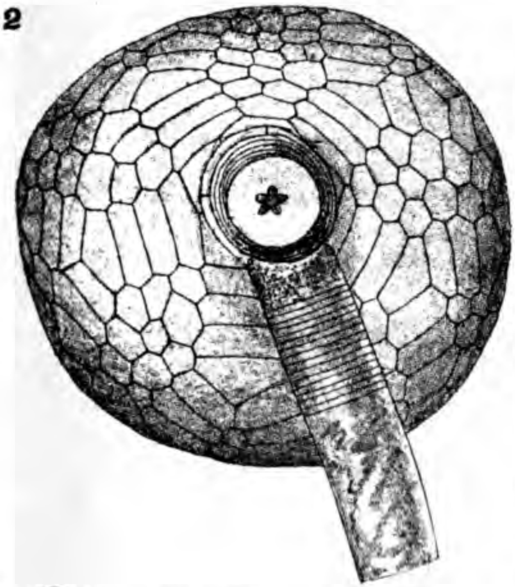

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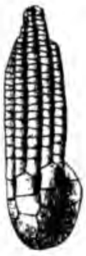

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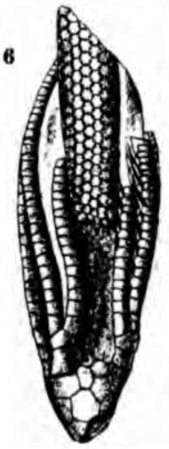

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PLATE V.

Page.

FORBESIOCRINUS MACADAMSI, n. sp. .... [illegible]

Fig. 1. Azygous view.
Fig. 2. Opposite side view.

CARYOCRINUS MILLIGANÆ, n. sp. .... [illegible]

Fig. 3. Azygous view.
Fig. 4. Summit.

CARYOCRINUS HAMMELLI, n. sp. 65

Fig. 5. Azygous view.
Fig. 6. Summit.

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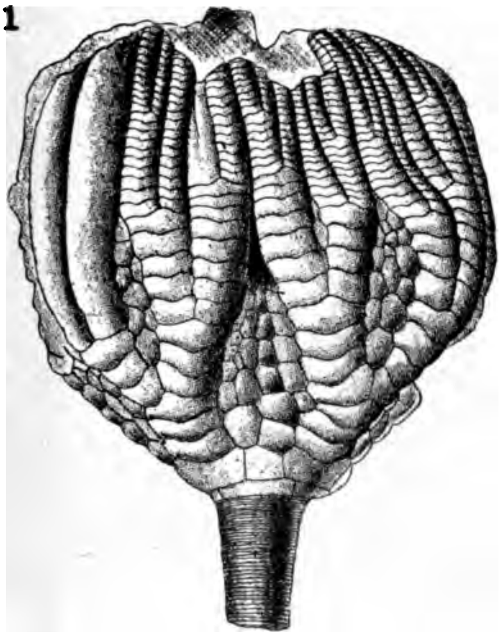

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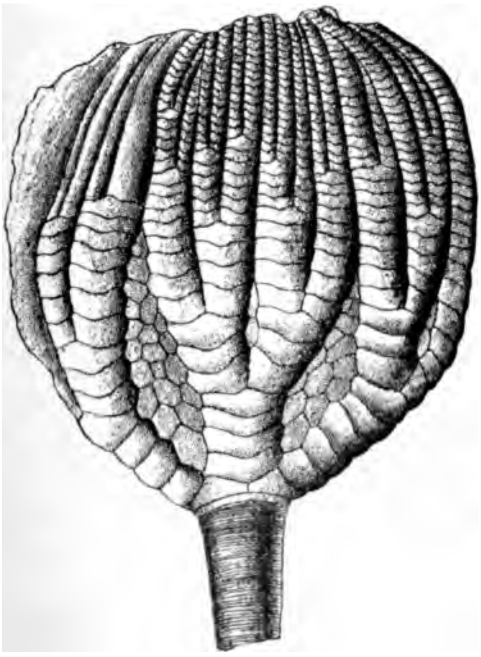

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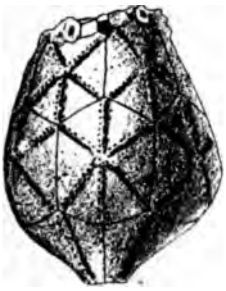

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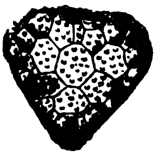

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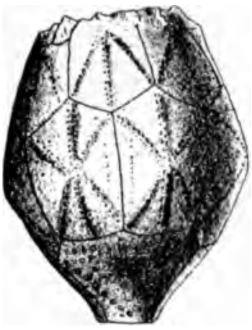

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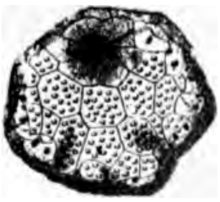

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BULLETIN NO. 10.

OF THE

ILLINOIS STATE MUSEUM

OF

NATURAL HISTORY.

NEW SPECIES OF ECHINODERMATA AND A NEW CRUSTACEAN FROM THE PALÆOZOIC ROCKS.

By S. A. MILLER and WM F. E. GURLEY.

Published quarterly by the Illinois State Museum of Natural History.
SPRINGFIELD, ILLINOIS.
JULY 10, 1896.

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SOME NEW SPECIES OF ECHINODERMATA AND A NEW CRUSTACEAN FROM THE PALÆOZOIC ROCKS.

BY S. A. MILLER AND WM. F. E. GURLEY.

SUBKINGDOM ECHINODERMATA.

CLASS CRINOIDEA.

ORDER PALÆOCRINOIDEA.

FAMILY ACTINOCRINIDÆ.

ACTINOCRINUS SAMPSONI, n. sp.

Plate I, Fig. 1, opposite azygous side; Fig. 2, azygous side on the right.

Species medium size. Calyx obconoidal, rather wider than long, plates convex and radiately sculptured. Superior part of interradial areas slightly depressed.

Basals form a low cup about three times as wide at the top as high. It is truncated below, about one-third wider than the diameter of the column, and bears an hemispherical depression for the attachment of the column. First primary radials about as long as wide, three hexagonal, two heptagonal. Second primary radials a little wider than long, about two-thirds as large as the first and hexagonal. Third primary radials about as large as the second, four of them pentagonal, the one on the left of the azygous area hexagonal. They are axillary, and bear upon each upper sloping side a single secondary radial, which is axillary, and, in four of the rays, bear upon each of the distal sides two tertiary radials, and upon each proximal side a single tertiary radial, which is axillary, and supports upon each upper side a single quaternary radial, which arrangement gives to each of these rays six arms. In the left lateral ray one of the proximal sides bears two tertiary radials and no quaternary plates, which gives to this ray five arms. There are, therefore, twenty-nine arms and twenty-nine ambulacral openings to the vault in this species.

The interradial areas all connect with the plates of the vault. In each regular interradial area the first plate is about the size of a second primary radial. It is followed by two smaller plates in the second range, and these by two smaller plates in the third range, and these by a single elongated plate in the fourth range, in each of three areas, that unites with two plates belonging to the vault. In the other area there are two elongated plates, in the fourth range, that unite with the plates of the vault. There is an elongated plate in each intersecondary area that separates the quaternary plates and unites with the plates of the vault in some of the areas. There are ten plates in the azygous area. The first one is in line with the first primary radials, but somewhat smaller. It is followed by two plates in the second range, three in the third, two in the fourth, and two narrow elongated plates in the fifth range, that unite with the plates of the vault.

The vault is highly convex, depressed toward the interradial areas, and covered by numerous polygonal plates, about one fourth of which bear spines. The proboscis is central, but broken off in our specimen.

This is the first twenty-nine armed species described from the Burlington Group, and so different from all thirty-armed species that no comparison with any of them is nesessary.

Found by F. A. Sampson, in whose honor the specific name is proposed, in the Burlington Group at Sedalia, Missouri, and now in his collection. Also found by R. A. Blair, and in the collection of S. A. Miller.

ACTINOCRINUS PETTISENSIS, n. sp.

Plate I, fig. 3, azygous side; fig. 4, opposite view.

Species medium size. Calyx obconoidal, one-third wider than high, plates convex and rather deeply, radiately sculptured.

Basals form a low cup, about four times as wide at the top as high. It is truncated below about one-half wider than the diameter of the colum and bears an hemispherical depression for the attachment of the column. First primary radials wider than long, three hexagonal, two heptagonal. Second primary radials nearly as long as wide, about two-thirds as large as the first and hexagonal. Third primary radials a little smaller than the second, wider than long, pentagonal, axillary, and bear upon each superior sloping side a single secondary radial, which is axillary and in one of the lateral rays supports, upon each upper sloping side, one or two tertiary radials, which gives to this ray four arms. In each of the other four rays, one of the proximal sides of the secondary radials bears a tertiary radial, which is axillary, and supports, on each upper sloping side, a quaternary plate, which arrangement gives to each of these four rays five arms. There are, therefore, in this species, twenty-four arms and twenty-four ambulacral openings to the vault.

The interradial areas connect with the vault. There are six plates in each regular interradial area. The first one is about the size of a second primary radial; it is followed by two smaller plates, in the second range, and these by two plates, less than one-third as large, in the third range, and above these, one quite small and narrow plate separates the tertiary radials. There is a small intersecondary plate in some of the areas, but it does not connect with the vault. There are ten plates in the azygous area. The first one is in line with the first primary radials, but somewhat smaller. It is followed by two plates, in the second range, three in the third, three in the fourth, and one in the fifth range that unites with the plates of the vault.

The vault is very highly convex and bears a central proboscis. It is covered with numerous polygonal plates, more than half of which bear long robust spines.

This is the first twenty-four armed *Actinocrinus* ever described, from any group of rocks, and while, in general outline, it bears some resemblance to *Actinocrinus fossatus*, a forty-armed species, yet the differences are so manifest that it would be idle to draw any comparison between the two.

It was found by the indefatigable collector, R. A. Blair, in the Burlington Group, at Sedalia, Missouri, and is now in the collection of S. A. Miller.

ACTINOCRINUS BISCHOFFI, n. sp.

Plate III, Fig. 1, azygous side; Fig. 2, opposite view; some of the plates around the arm openings are broken.

Species large. Calyx obconoidal, about as long as wide, abruptly spreading near the arm openings, which are directed upward, and are not visible in a basal view. Truncated only the diameter of the column. Plates plain or slightly convex. Sutures beveled; no radial ridges.

Basals form a cup about two and a half times as wide as high, and which is moderately constricted in the middle part. First primary radials as long as wide, three hexagonal, two heptagonal. Second primary radials about half as large as the first, hexagonal, and a little wider than long. Third primary radials smaller than the second, the one opposite azygous area heptagonal, three hexagonal and one pentagonal, axillary, and support on each upper side a secondary radial, which is axillary and supports, on each of the distal sides, four tertiary radials, and upon each of the proximal sides an axillary tertiary radial, which supports, on each upper side two or three quaternary radials, which arrangement gives to each of the rays six arms. There are, therefore, thirty ambulacral openings to the vault in this species.

None of the interradial areas connect with the vault. In each of three of the regular interradial areas there are seven plates, one, followed by two, in the second range, two in the third range, and two in the fourth range, which are below the tertiary radials. In the other area there are eight plates, the additional one being in the fifth range. There is a small intersecondary plate in the ray opposite the azygous area. There are thirteen plates in the azygous area. The first one is in line with the first primary radials and of the same size. It is followed by three plates, in the second range, four plates in the third range, three in the fourth range, one in the fifth range, and one in the sixth range. The last plate is small and below the union of the last two tertiary radials, in the adjoining radial series.

The vault is highly convex and covered with small, convex, polygonal plates. It bears a subcentral proboscis. The arm openings are directed upward and visible in a summit view. No ovarian pores have been discovered.

This is a very strongly marked and distinct species, and bears so little resemblance to any other one that has been described that no comparison with any of them is necessary. In form it is somewhat like *A. glans*, but that is a twenty-armed species, has fewer plates, in the interradial areas, and has only two plates in the second range, in the azygous area. Indeed, they have too little resemblance to each other to make any useful comparison.

Found in the Burlington Group, at Burlington, Iowa, and now in the collection of Prof. Martin Bischoff, of Buffalo, New York, in whose honor we have proposed the specific name.

ACTINOCRINUS SPECTABILIS, n. sp.

Plate III, Fig. 3, azygous side.

Species below medium size. Calyx obpyramidal, about as long as wide, moderately truncated, most rapidly spreading toward the free arms. Ambulacral openings directed upward, and not visible in a basal view. Radial ridges defined. Interradial areas somewhat flattened and cut off from any connection with the vault, except by a single plate in the azygous area. Surface granular.

Basals form a low cup about two and a half times as wide as high. First primary radials longer than wide, three hexagonal, two heptagonal. Second primary radials about two-thirds as large as the first, hexagonal, and a little wider than long. Third primary radials a little smaller than the second, heptagonal, axillary and support on each upper sloping side a single secondary radial which is axillary and supports, on each upper sloping side, a single tertiary radial, which gives to each ray four arms. There are, therefore, twenty arms in this species.

In each of the regular interradial areas there are five plates, one, followed by two, in the second range, and two in the third range. In each of the other regular interradial areas there are seven plates, one in the first range, two in the second, two in the third and two in the fourth, the last being cut off from any connection with the vault by the union of the tertiary radials. In the azygous area there are sixteen plates. The first one is in line with the first primary radials and of about the same size. It is followed by two plates in the second range, four in the third range, five in the fourth range, three in the fifth range, and one in the sixth range that separates the tertiary radials and extends to the vault plates.

The vault is depressed, convex, covered with small polygonal plates, and bears a small subcentral proboscis. The ambulacral openings are directed upward and visible in a summit view. No ovarian pores discovered.

This species is distinguished by its general form from all other twenty-armed species heretofore described, and no comparison with any of them is necessary.

It was found in the Burlington Group, at Burlington, Iowa, and is now in the collection of S. A. Miller.

ACTINOCRINUS SOBRINUS, n. sp.

Plate III, Fig. 4, azygous side; Fig. 5, opposite view.

Species below medium size. Calyx obpyramidal one-half wider than high, truncated only the size of the column, most rapidly spreading toward the free arms. Ambulacral openings directed upward and not visible in a basal view. Radial ridges strongly defined. Interradial areas flattened in the lower part and depressed between the arms, where the plates unite with those of the vault. Plates convex.

Basals form a low cup three times as wide as high. First primary radials wider than long, three hexagonal and two heptagonal. Second primary radials about half as large as the first, hexagonal, wider than long. Third primary radials about as large as the second, three hexagonal, two heptagonal, axillary and support on each upper sloping side a single secondary radial, which is axillary and supports, on each upper sloping side, a single tertiary radial, which gives to each ray four arms. There are, therefore, twenty arms in this species.

There are seven plates in each regular interradial area, one in the first range, two in the second range, two in the third range, and two in the fourth range, which separate the tertiary radials and unite with the plates of the vault. There are fourteen plates in the azygous area. The first is in line with the lower part of the first primary radials, and rather more than half as large as one of them. It is followed by a single plate in the second range of about the same size. Suppose this to be abnormal, then these two plates would represent the first plate, as usually found in this genus, and the two plates would be larger than a first primary radial and it would reduce the number of plates, in the azygous area, to thirteen. We are of the opinion that this feature is abnormal and that another specimen may show a single plate instead of two. In the next range there are three plates, in the next four, in the next three, and in the next two, which separate the tertiary radials and unite with the plates of the vault.

The vault is depressed, convex, covered with polygonal plates, and bears a small subcentral proboscis. The ambulacral openings are directed upward and visible in a summit view. No ovarian pores discovered:

This species is a cousin of *A. spectabilis*, above described, if not nearer related. It will be noticed that this is a shorter form, and radial ridges more prominent than in *A. spectabilis*, but such differences are not of specific importance when the arm formulas are the same. The differences between the two that may be of specific value are these: In this species each regular interradial area has seven plates, two of which connect with the plates of the vault; in *A. spectabilis* none of the plates in the regular interadial areas connect with the vault, and, in each of two of them, there are only five plates. In this species, supposing the division of the first plate, in the azygous area, to be normal, there are thirteen plates in the azygous area, the last two being comparatively large and connecting with the plates of the vault; in *A. spectabilis* there are sixteen plates, in the azygous area, only one of which connects with the plates of the vault. We have frequently found as much difference, in the number of interradials, in different specimens, in the same species, as we find in these two species; but not under the same circumstances. It is the difference in the number of plates, coupled with the fact that the interradial areas are connected with the vault in one case, and not in the other, that we are inclined to think is of specific value. There does not seem to be anything abnormal about our specimens except the division of the first azygous plate.

Found in the Burlington Group, at Burlington, Iowa, and now in the collection of A. Albers.

ACTINOCRINUS SUBSCITULUS, n. sp.

Plate III, Fig. 6, azygous side; Fig. 7, opposite view; Fig. 8, summit.

Species above medium size. Calyx obpyramidal, nearly as long as wide, truncated only the size of the column, most rapidly spreading near the free arms. Radial ridges well defined above the first primary radials. Interradial areas concave and depressed between the arms where the plates unite with those of the vault. Ambulacral openings directed upward and not visible in a basal view. Plates slightly convex. Surface granular.

Basals form a cup about twice as wide as high, and which is much constricted in the middle part. First primary radials longer than wide, three hexagonal, two heptagonal. Second primary radials less than half as large as the first, hexagonal, wider than long. Third primary radials about the size of the second, three heptagonal, two hexagonal, axillary, and support on each upper sloping side a single secondary radial, which is axillary, and in each of four of the rays support on each upper sloping side two tertiary radials, which gives to each of these rays four arms. In one of the lateral rays, the third primary radial supports, upon one side, an axillary, secondary radial, which supports upon each upper side two tertiary radials, and, upon the other side, a secondary radial that supports, on the distal side, two tertiary radials, and, upon the proximal side, an axillary tertiary radial, which bears upon each upper sloping side a quaternary radial, which arrangement gives to this ray five arms. There are, therefore, twenty-one arms in this species. The arm formula is 4+5+4+4+4.

The regular interradial areas connect with the vault, but they differ widely from each other. In one area there are eleven plates, in another ten, in another nine and in the other eight. Figure 7 shows one area with eight plates and the other with eleven plates. The azygous area is wide, flattened, and contains thirteen plates. The first plate is in line with the first primary radials, and of the same size. It is followed, in the second range, by two plates; in the third range, by five plates; in the fourth range, by four plates, and, in the fifth range, by one plate, that unites with the plates of the vault.

The vault is convex and covered with numerous, more or less convex, polygonal plates. It bears a subcentral proboscis. The arm openings are directed upward and are visible in a summit view. No ovarian pores discovered.

This is the first twenty-one armed *Actinocrinus* ever described from the Burlington Group, and hence there is no necessity for comparing it with any other species. Indeed, it is so far removed from all other species, in its essential structure, that it would be difficult to make a comparison with any of them.

Found in the Burlington Group, at Burlington, Iowa, and now in the collection of Wm. F. E. Gurley.

ACTINOCRINUS SUBPULCHELLUS, n. sp.

Plate III, fig. 12, azygous side; fig. 13, opposite view; fig. 14, summit.

Species medium or below medium size. Calyx obpyramidal, one-third wider than high, moderately truncated below, pentagonal above, in transverse section; radial ridges sharp, interradial areas flattened. Plates convex or nodose.

Basals form a low hexagonal cup, about three times as wide as high. The sutures are beveled, the basals are expanded below, and the sharp, radial ridges are extended across the basals, though not prominent. The first primary radials are as long as wide, three hexagonal, two heptagonal, and each one bears a central node. Second primary radials hexagonal, about two-thirds as large as the first, wider than long. Third primary radials smaller than the second, pentagonal, axillary, and support, on each upper sloping side, a single secondary radial which bears the free arms. There are, therefore, ten arms in this species. An intersecondary plate separates each pair of ambulacral openings to the vault.

The first regular interradials are rather larger than the second primary radials, slightly convex, not nodose. There are two plates in each second range and two in the third range that separate the arm openings and unite with the plates of the vault. The first azygous plate is in line with the first primary radials, of about the same size, and bears a central node. It is followed by two slightty convex plates, in the second range, three in the third range, and five smaller plates in the fourth range that separate the ambulacral openings and unite with the plates of the vault.

The vault is only moderately convex, covered with polygonal plates and bears a subcentral proboscis.

This species would seem to be more nearly related to *Actinocrinus multiradiatus*, than to any other described species, but it is so different in form and in surface ornamentation that no comparison is necessary to distinguish them.

Found in the Burlington Group, at Burlington, Iowa, and now in the collection of Wm. F. E. Gurley.

PHYSETOCRINUS SAMPSONI, n. sp.

Plate I, fig. 5, azygous side; fig. 6, opposite view; fig. 7, summit.

Species medium size. Calyx obconical, rather broadly truncated below and stelliform, as seen from above, in consequence of the horizontal, rigid extension of the five radial series. The abrupt, horizontal extension of the radial series commences at the top of the third primary radials. Plates thick and nodose.

Basal plates form an hexagonal disc four times as wide as high, stand upright and evenly truncated below. The first primary radials are the largest plates in the body, about as long as wide, three hexagonal, two heptagonal. Second primary radials about one-third as large as the first and hexagonal. Third primary radials about half as large as the second, pentagonal, axillary, and support, on each superior side, a single secondary radial, which is axillary, and supports, on each upper side, a single tertiary radial, which gives to each ray four arms. There are, therefore, twenty arms in this species.

The interradial areas all connect with the vault, but they differ much from each other. The first plate is about the size of a second primary radial, and it is followed by two smaller plates, in the second range. In one of the areas there are four plates, in the third range, that separate the radial series and curve over upon the vault, where they unite with the summit plates. In each of the two areas, there are three plates, in the third range, that unite with the plates of the vault. In the other area there are two plates, in the third range, that are followed by three plates, in the fourth range, that curve over and unite with the plates of the vault. In the azygous area, the first plate is in line with the first primary radials and like them, except somewhat smaller. It is followed by two plates, in the second range, and by three in the third range, one of which is elongated and curves over so as to unite with the plates of the vault. There are two plates, in the fourth range, even with the superior end of the elongated plate belonging to the third range, that unite with the plates of the vault.

The vault is depressed, convex, and covered with polygonal, slightly convex plates of very unequal size. The orifice is small and subcentral.

This species is so distinct from all others that no comparison with any of them is necessary. Heretofore, there has never been described a twenty-armed species of *Physetocrinus*, except *Physetocrinus copei*, which is far removed from this species, in all other respects.

Found by F. A. Sampson, in whose honor we have proposed the specific name, in the Burlington Group, at Sedalia, Missouri, and now in his collection.

DORYCRINUS ALABAMENSIS, n. sp.

Plate III, fig. 15, basal view; fig. 16, summit view; fig. 17, azygous side; the specimen illustrated is a cast from the chert.

Species medium size, calyx and vault subequal, outline subspheroidal, arms directed below a horizontal line. Calyx basin-shaped, rounded below, more than twice as wide as high. Ambulacral openings directed horizontally or below a horizontal line and not visible in a basal or summit view. This species is founded upon a very perfect cast in chert, of the interior of the test, and, therefore, does not show the surface ornamentation, or surface character of the plates except it shows the existence of radial ridges, by the radial furrows within the radial plates.

Basals form an hexagonal disc, very little larger than the diameter of the column, with a strongly marked re-entering angle on the azygous side. First primary radials, a little larger than wide, three hexagonal, two heptagonal. Second primary radials a little wider than long, three pentagonal, two hexagonal, caused by the slight truncation of some of the angles, by the plates, in the second interradial ranges. Third primary radials about the size of the second, three hexagonal, two pentagonal, axillary and supporting, upon each superior sloping side, two secondary radials, the last being axillary and supporting, upon each outer sloping side, a free arm, which gives to each ray four arms. There are, therefore, twenty arms in this species.

In each regular interadial area there are five plates; one, followed by two in the second range, and two in the third range, which widely separate the arms and unite with the plates of the vault. In one area, however, the first plate is divided horizontally, so as to give the area six plates, which may or may not be abnormal. The azygous area is wide and the plates of the calyx graduate into those of the vault, without any distinct line of separation. The first plate is in line with the first primary radials and fully as large as either of them. It is followed by three plates, in the second range, the middle one being the smallest. There are four plates in the third range and four in the fourth range, the latter being of unequal size and forming an irregular range. Some of the plates, in the fifth range, abut upon the plates that surround the azygous orifice, which is situated upon the side, below the summit of the vault.

The vault is highly convex and has greater capacity than the calyx itself. There is a very large subcentral plate surrounded by eight plates, four of which are large, two are medium size, and the other two are smaller and abut upon the azygous orifice. The cast shows a pit in each of the four large plates, and in the interambulacral plates below, but there are none, in the ambulacral plates. There is also a pit subcentrally where the large subcentral plate rested. Probably these pits indicate spine-bearing plates.

This species bears little or no resemblance to any twenty-armed species heretofore described, and the test, if ever discovered, can probable be identified. At least, the test is as likely to be identified from the cast as the cast would have been from the test, if we had described the test instead of the cast. Twenty-armed species prevail, in the Keokuk Group, over other forms, and twelve and sixteen-armed species prevail in the Burlington Group, over other forms. The general form of this species is more like the prevailing forms in the Keokuk, than the prevailing forms in the Burlington, and without having examined the rocks from which it was collected, we suppose it was from the Keokuk Group.

Found at a place called Chert Hill, in Alabama, supposed to be of the age of the Keokuk Group, and now in the collection of Charles L. Faber.

DORYCRINUS SAMPSONI, n. sp.

Plate III, Fig. 20, azygous side; Fig. 21, opposite view; Fig. 22, summit, part of the spines are broken off.

Species above medium size. Body somewhat urn-shaped, base expanded, subcylindrical from the base of the third primary radials, and then abruptly expanded horizontally to the free arms, where the body has a subpentagonal outline, and above which the vault is perpendicularly elevated, preserving the subpentagonal outline a distance nearly equal to the height of the calyx and having a nearly flat summit. The expansion of the calyx from the basals to the third radials is less than the expansion of the base itself. The plates are convex or tumid. Ambulacral openings directed horizontally and not visible in a basal or summit view.

Basals the largest plate in the body, constricted in the superior part and broadly flanged below. The bottom is concave, and columnar canal small. First primary radials a little wider than long, each one bears a transverse central node, three hexagonal, two heptagonal. Second and third primary radials together very little more than half as large as the first. Second primary radials quadrangular, two or three times as wide as high. Third primary radials about the size of the second, three hexagonal, two pentagonial, curved outward, axillary, and, in the ray on each side of the azygous area bear a single secondary radial, on each outward sloping side, which is directed horizontally and bears upon each outward sloping side a single tertiary radial which gives to each of these rays four arms. In the ray opposite the azygous area, the third primary radial bears upon one outward side two secondary radials and upon the other an axillary secondary radial, which supports upon each outward side a single tertiary radial, which gives to this ray three arms. In each of the lateral rays, the third primary radial bears upon each superior, outward sloping side two secondary radials, which gives to each of these two arms. There are, therefore, fifteen arms in this species. The arm formula is 4 + 2 + 3 + 2 + 4.

The regular interradial areas are elongated, unequal, and connected with the vault. In one area there are two plates, one, followed by an elongated plate that connects with the vault. In another area there are four plates, one, followed by two plates in the second range, and an elongated plate that connects with the vault, in the third range. In each of the other two areas there are three plates, one, followed by two in the second range, that connect with the plates of the vault. The interradial areas are depressed below the radials, which gives the subpentagonal outline to the body. The azygous area is nearly perpendicular from the constriction of the basals to the orifice, with a central longitudinal, convex ridge. The first azygous plate is in line with the first primary radials, larger than either one of them, and bears a transverse central node. It is followed, in the second range, by three plates, the middle one being the largest and most convex. The middle one is followed by two large nodose plates, the last one of which abuts upon the azygous orifice. The plates upon each side of the longitudinal central ridge, formed by these nodose plates above the second range, are small and depressed. On one side, below the plates surrounding the orifice, there are three plates and on the other four. The azygous orifice is surrounded by five plates and is situated below the level of the horizontally extended spines belonging to the vault.

The vault is elevated above the ambulacral openings so that a transverse section is subpentagonal, but it is stellate, as seen from above, by reason of a very large plate above each radial series' terminating in a large spine, directed horizontally. In each of the lateral rays a large elongated plate separates the small ambulacral openings and extends to the inferior side of the spinous plate In the other rays an elongated plate occupies the same position, and laterally there are two plates extending to the spinous plate, the lower ones separating the ambulacral openings. The vault is nearly flat on the top, where it is covered by a few convex plates and a large central spinous plate. There are, therefore, six plates that terminate in spines, one central and directed upward and one over each radial series directed horizontally. Each spine is abruptly contracted or constricted, in the middle part, and then extends without tapering until it approaches the point. The point is broken off from each of the spines, in our specimen, but one of them is evidently nearly complete, as shown in the illustration.

There are two large, elongated plates in each interambulacral area, followed by two large plates, that separate the spine-bearing plates and curve over upon the vault. The central spine-bearing plate is surrounded by a circle of eleven plates, which nearly cover the summit.

There has never been but one fifteen-armed species described from the Burlington Group, and it has no resemblance to this one, and no comparison is therefore necessary to distinguish it. In general form it bears some resemblance to *D. intermedius* and *D. missouriensis*, but it is so widely different, without resorting to the arm formula, that they cannot be mistaken for each other. *D. intermedius* is a nineteen-armed species, and *D. missouriensis* a twelve-armed species.

Found by F. A. Sampson, in whose honor we have proposed the specific name, in the Burlington Group, at Sedalia, Missouri, and now in his collection.

DORYCRINUS FABERI, n. sp.

Plate I, Fig. 8, azygous side; Fig. 9, opposite view; Fig. 10, summit, part of the spines are broken off.

Species small. Calyx obpyramidal, from two to two and a half times as wide as high, truncated and flanged at the base. Radial ridges angular. Surface granular. Sutures not beveled. Column quite small.

Basals form a short subhexagonal disc, two and a half times as wide as the diameter of the column, the upper part being constricted and the lower part having a moderately concave depression, for the attachment of the column. First primary radials, the largest plates in the calyx, longitudinally angular in the middle, a little wider than long, three hexagonal, two heptagonal. Second primary radials about one-third as large as the first, quadrangular, and from two to two and a half times as wide as long. Third primary radials about one-half larger than the second, pentagonal, axillary, and, in four of the rays, support on each upper sloping side a single, secondary radial, which gives to each of these rays two arm openings to the vault. In the ray, on the right of the azygous area, the third primary radial bears upon the distal side two secondary radials and upon the proximal side a single secondary radial, which is axillary and supports, upon each upper sloping side, a single tertiary radial, which arrangement gives to this ray three arm openings to the vault. There are, therefore, eleven arm openings to the vault in this species.

In each regular interradial area there is one large, flat plate, followed by two narrow, elongated ones that unite with the plates of the vault. The first azygous plate is in line with the first primary radials and about as large as the smaller one. It is followed by three plates in the second range, the middle one being the largest. There are four plates in the third range, and one of the middle ones extends up to the azygous orifice and is truncated by it.

The vault is somewhat elevated over the ambulacral orifices and depressed convex centrally. The largest plate is subcentral, on the azygous side, and bears a long, robust spine. Each plate over a junction of the ambulacral canals bears a long spine. Otherwise the plates covering the vault are plane or slightly convex. Nine plates abut upon the subcentral, spine-bearing plate, two of which are truncated by the azygous orifice. Four plates only abut upon the minute azygous orifice, which is situated on a bulbous elevation, about on a level with the summit of the vault, and opens out horizontally.

This is the first eleven-armed *Dorycrinus* ever described, and hence it is distinguished, by that character alone, from all other species. The six spinous plates on the vault and plane surface of the other plates will distinguish it again from *D. unicornis.* It will also be distinguished from that species by the two plates in the second range, in each regular interradial area. And again, by the third range of plates, in the azygous area, and, again, by the fact that, in that species, there are numerous small plates surrounding the azygous orifice, while, in this, five plates constitute the azygous bulb and four of these abut upon the orifice. The surface of the plates, too, in the calyx of that species bears short spines or the plates are very tumid, while, in this, the plates are plane with the exception of the angular radial ridges. *Dorycrinus unicornis* has a wide range. We have examined it from various localities, in Iowa, from Adams county, Illinois, and from Sedalia, Blackwater and other places in Missouri, and the differences shown by the specimens from these distant localities are very slight, and usually consist in the character of the plates, which differ in their convexity, some having cuneiform spines on the larger plates, and others having a plate here or there with a sharp spine. We have examined specimens varying from an eighth of an inch to an inch and a half in diameter, possessing, in every respect, the same substantial characters. Occasionally there is an increase in the number of plates, in the interradial or azygous areas or on the vault, from the normal number, but the radial plates and twelve ambulacral openings are features that remain unchanged.

Found in the Burlington Group, at Burlington, Iowa, and now in the collection of Charles L. Faber, in whose honor the specific name is proposed.

AMPHORACRINUS JESSIEÆ, n. sp.

Plate III, Fig. 18, azygous side, the vault retains part of the matrix, hence the transverse truncation of the figure; Fig. 19, basal view.

Species rather below medium size. Calyx bowl-shaped, somewhat broadly truncated or flattened below, and subpentagonal in transverse section above, nearly twice as wide as high. Radial ridges defined from the center of the first radial upward, and becoming stronger as the arms are approached. Plates convex and more or less pyramidal.

Basals form an hexagonal disc, with re-entering angles, about one-third wider than the diameter of the column, which attached in a moderately concave depression. First radials longer than wide, and abruptly curve upward from the central, angular, commencement of the radial ridges, three hexagonal, two heptagonal. Second radials about two-thirds as large as the first, wider than long, hexagonal. Third primary radials short, much smaller than the second, pentagonal, axillary, and support on each upper sloping side a single small secondary radial, which is axillary, and supports upon each superior sloping side a free arm. The secondary radials and arms are directed nearly horizontally. There are four arms to each ray, or twenty arms belonging to this species. The arms are very small and round on the lower side.

The interradial areas curve over upon the vault so as to leave the radial series standing out prominently. There are three regular interradials in each area. The first one is larger than a second primary radial, and is followed by two plates in the second range that connect with the plates of the vault. The first azygous plate is in line with the first primary radials and somewhat smaller. It is followed by two plates in the second range, and by three in the third range, that connect with the plates of the vault.

The vault is depressed convex and bears a subcentral proboscis, but the matrix adheres, in our specimens, so as to prevent a full description of it.

This species is so different from all others that have been described that no comparison is necessary.

Found by Miss Jessie Blair, in whose honor we have proposed the specific name, in the Choteau limestone, at Sedalia, Missouri, and now in the collection of S. A. Miller.

BATOCRINUS NODOSARIUS, n. sp.

Plate I, Fig. 11, side view, with azygous area on the right; Fig. 12, summit view.

Species medium or below medium size, biturbinate. Calyx obconoidal, in the lower part, and spreading, nearly horizontally, in the superior part, truncated at the base; about twice as wide as high; arm openings directed horizontally; plates convex, the larger ones tumid; surface granular.

Basals form a low cup or hexagonal disc, with slight re-entering angles, about twice as wide as the diameter of the column. It is constricted, in the upper part, and the plates extend a little below the point of columnar attachment. First radials tumid, about one-half wider than high, three hexagonal, two heptagonal. Second primary radials short, quadrangular, three or four times as wide as long. Third primary radials about twice as large as the second, pentagonal, axillary, and in each lateral ray, and, in the ray on each side of the azygous area, bear, upon each upper sloping side, two secondary radials. The second secondary radials are axillary, and, in each of the lateral rays, bear, upon each superior sloping side, two tertiary radials, which gives to each of these rays four arms. The proximal sides of the secondary radials, in each ray adjoining the azygous area, bear two tertiary radials, and the distal sides bear a single tertiary radial, which is axillary, and supports, upon one side, a single quaternary plate, and, upon the other, two quaternary plates, which arrangement gives to each of these rays six arms. In the ray opposite the azygous area, the third primary radial bears, upon one side, four secondary radials, and upon the other, two, the last being axillary, and supporting, upon each upper sloping side, two tertiary radials, which gives to this ray three arms. There are, therefore, twenty-three arms in this species. The arm formula is 6+4+3+4+6.

In each regular interradial area there is a large tumid plate, and, in two of the areas, it is followed by a very small plate. The azygous area contains only four plates. The first one is in line with the first primary radials and quite as large as either of them. It is followed by three plates, the middle one being the largest, and cut off from the plates of the vault by the union of the quaternary radials above it.

The vault is highly convex and covered with numerous polygonal, nodose plates. It bears a subcentral proboscis.

This species differs, in general outline, and in the surface of the plates, from *B. subaequalis* of McChesney, which has three regular interradials in each area and seven or eight irregularly arranged plates, in the azygous area, beside the arm formula, in that species, is 6+4+4+4+5. The two species have so little resemblance to each other, though they have the same number of arms, that no further comparison is necessary. This species has even less resemblance to *B. pistillus* of Meek & Worthen, which has four regular interradials and seven or eight azygous plates and the arm formula of 5+4+4+5+5. These are the only twenty-three armed species, that have been described from the Burlington group, and our species cannot be mistaken for any other.

Found in the Burlington Group, of Adams county, Illinois, and now in the collection of Charles L. Faber.

BATOCRINUS LEVIS, n. sp.

Plate I, Fig. 13, basal view; Fig. 14, azygous side; Fig. 15, summit view.

Species medium or below medium size, calyx somewhat obconoidal, rounded below, broadly constricted in the middle and more or less quinquelobate when seen from above, caused by the depression, at the interradial areas. There is considerable variation of the forms in different specimens. Surface of the plates, plane and smooth, those of the vault sometimes slightly convex.

Basals form a low cup having a round, hemispherical depression below for the attachment of the column. In some specimens the lower part of the cup is rounded into the columnar depression, and upward from it, in others, there is more or less angularity. The cup at the top is about twice the diameter of the column. First radials the largest plates in the body, a little wider than long, three hexagonal, two heptagonal. Second radials small, quadrangular, three or four times as wide as long. Third radials very little larger than the second, pentagonal, axillary and bear upon each superior sloping side, in four of the rays, two secondary radials, the last ones being axillary and supporting on each upper side two tertiary radials, which gives to each of these rays four arms and four ambulacral openings to the vault. In the ray opposite to the azygous area, the third primary radial bears upon each superior sloping side three secondary radials which gives to this ray two arms. There are, therefore, eighteen arms and eighteen ambulacral openings to the vault in this species. The arm formula is 4 + 4 + 2 + 4 + 4, and there is no variation among the specimens examined.

There are three regular interradials in each area, one followed by two more or less elongated plates in the second range, which are cut off from the plates of the vault by the union of the last radials. The first one is in line with the first primary radials and nearly as large. It is followed by three subequal plates, in the second range, and by three plates, very unequal in size, in the third range. Above these, in the fourth range, there are two elongated plates that connect with the plates of the vault.

The vault is only moderately convex, except near the azygous orifice, where it is elevated more abruptly. It is depressed toward the margin, in the interradial areas. It is covered with smooth plates, some of which are convex. There is no proboscis, though the azygous orifice is somewhat elevated subcentrally. The ambulacral openings are directed upward, at an angle of about forty five degrees, and are seen in a summit view, but are not visible in a basal view of the calyx. No ovarian pores discovered.

This species bears little or no resemblance in general form or surface features to any other eighteen-armed described species and cannot be mistaken for any of them. In form and absence of surface ornamentation and position of the azygous orifice, it resembles *Batocrinus hageri*, McChesney. That species, however, has twenty arms, four in each radial series, while this has only eighteen, or two only, in the ray opposite to the azygous area, and this feature alone is sufficient to distinguish the species. There are minor differences in the regular and azygous areas.

Found in the Burlington Group, at Burlington, Iowa, and now in the collection of A Albers, S. A. Miller and Wm. F. E. Gurley. The specimen illustrated is from the collection of Mr. Albers.

BATOCRINUS ENODIS, n. sp.

Plate I, Fig. 16, basal view; Fig. 17, azygous side; Fig. 18, summit view.

Species variable in size and in form, one of the specimens examined has a diameter little more than half that of the one illustrated. Calyx and vault subequal in size, and much alike in form. Calyx saucer-shaped, rapidly expanding from the column to the arms. Ambulacral openings directed upward at an angle of about forty-five degrees, and not visible from a basal view. Surface of the plates plane and smooth, some of those on the vault sometimes slightly convex.

Basals form a low, concave, hexagonal disc, with obscure reëntering angles, having a round, hemispherical depression for the attachment of the column, and about one and a half times the diameter of the column. First primary radials nearly twice as wide as long, three hexagonal, two heptagonal. Second primary radials about half as large as the first, quadrangular, and two or two and a half times as wide as long. Third primary radials somewhat smaller than the first, twice as wide as long, three hexagonal, two pentagonal, axillary, and in one of the lateral rays, on each side, and in the ray opposite the azygous area, support on each superior lateral side, two secondary radials, the last ones being axillary and supporting on each upper side two tertiary radials, which gives to each of these three rays four arms and four ambulacral openings to the vault. In the ray on the right of the azygous area, the third primary radial bears upon the distal side two secondary radials, the last one being axillary and supporting, on the distal side, two tertiary radials, and, on the proximal side, one tertiary radial, which is axillary and supports upon each upper side a quaternary radial; and bears upon the proximal side one secondary radial, which is axillary and supports, on the distal side, three tertiary radials, and, upon the proximal side, two tertiary radials, the last being axillary and supporting, on each upper sloping side, two quaternary radials, which arrangement gives to this ray six arms. In the ray on the left of the azygous area, the third primary radial bears, upon the distal side, two secondary radials, the last being axillary and supporting, upon each upper sloping side, two tertiary radials, and bears upon the proximal side one secondary radial, which is axillary and supports upon the distal side two tertiary radials, and upon the proximal side a single tertiary radial, which is axillary and supports on each superior side two quaternary radials, which arrangement gives to this ray five arms. There are, therefore, twenty-three arms and twenty-three ambulacral openings to the vault in this species. The arm formula is 6+4+4+4+5.

All of the interradial areas are cut off from the vault. In one of the regular interradial areas there are two plates, one following the other. In another area there are four plates, one followed by two, in the second range, and one in third. In each of the other two areas there are three plates, one followed by two, in the second range. This is the structure of the type specimen, but other specimens may show some differences in the regular areas. In the azygous area there are seven plates. The first plate is in line with the first primary radials, but not near as wide, though somewhat longer. It is followed by three rather large subequal plates, in the second range, and these by three, in the third range, the middle one of which is quite large and the lateral ones small. This area is entirely cut off from the vault by the union of the quaternary radials.

The vault is highly convex, or subconoidal, and covered with smooth, polygonal plates. The azygous orifice is subcentral and elevated above the surrounding summit, but there is no proboscis. The ambulacral openings are visible in a summit view. No ovarian pores discovered.

This species bears little or no resemblance to any other twenty-three armed species that has been described, either in general form or surface features, and cannot be mistaken for any of them. In its smooth surface it resembles *B. dodecadactylus*, *B. rotundus*, *B. oblatus*, *B. hageri*, *B. levis*, and other species herein described, though otherwise its affinities would seem to be with

B. rotundus and *B. oblatus*. In form it approaches *B. rotundus*, but that species has twenty-one ambulacral openings to the vault, as follows: 5+4+4+4+4, while this species has twenty-three, as follows: 6+4+4+4+5. They also differ in the regular and azygous areas. It differs in form from *B. oblatus*, which has twenty two arms, as follows: 5+4+4+4+5, and it differs in the azygous and interradial areas. There is no reason why it should be mistaken for either of these species. *B. rotundus* is the prevailing form in Missouri, where this species is yet unknown; while *B. oblatus* is the prevailing form in Iowa and some localities in Illinois, where *B. rotundus* also occurs, and where this species is also found.

Found in the Burlington Group, at Burlington, Iowa. The type is from the collection of S. A. Miller; other specimens are in the collection of A. Albers.

BATOCRINUS COMPLANUTUS, n. sp.

Plate I, Fig. 19, azygous side; Fig. 20, opposite view.

Species variable from below to above medium size. We have specimens smaller and others larger than the one illustrated. Vault smaller than the calyx. Calyx obconoidal, rapidly expanding from the column to the arms. Ambulacral openings directed above an horizontal line and not visible, in a basal view. Surface of the plates plain and smooth, some of them on the vault, sometimes slightly convex.

Basals form a low, hexagonal cup, with re-entering angles and having a round, hemispherical depression for the attachment of the column. The cup is a little more than twice the diameter of the column. First primary radials one-half wider than long, three hexagonal, two heptagonal. Second primary radials about one-third as large as the first, quadrangular, and about twice as wide as long. Third primary radials a little larger than the second, four hexagonal, one pentagonal, axillary, and in four of the rays bear, upon each superior sloping side, two secondary radials, the last of which are axillary and bear upon each upper sloping side two tertiary radials, which arrangement gives to each of these rays four arms and four ambulacral openings to the vault. In the ray opposite the azygous area the third primary radial supports on one upper sloping side three secondary radials and upon the other two secondary radials, the last one being axillary and supporting upon each upper side two tertiary radials, which arrangement gives to this ray three arms. There are, therefore, nineteen arms and nineteen ambulacral openings to the vault in this species. The arm formula is 4+4+3+4+4.

All of the interradial areas are cut off from the vault. In each of the regular interradial areas there are three plates, one, followed by two in the second range. In each of the other two regular interradial areas there are four plates, one, followed by two in the second range and by one in the third range. In the azygous area there are eleven plates. The first plate is in line with the first primary radials and nearly as large. It is followed by three plates in the second range, four in the third range, two in the fourth range and one in the fifth range, which is cut off from the vault by the union of the second tertiary radials.

Vault highly convex or obconoidal, covered with smooth polygonal plates, and bearing a subcentral proboscis. The ambulacral openings are visible in a summit view. No ovarian pores discovered.

This species bears little or no resemblance in general form or surface features to either *B. attenuatus* or *B. nodulosus*, the other two nineteen-armed species heretofore described from the Burlington Group, and cannot be mistaken for either of them. In its smooth surface and general form its affinities would seem to be with *B. rotundus*, *B. oblatus* and *B. enodis*, above described. This species, however, has only nineteen ambulacral openings to the vault, while *B. rotundus* has twenty-one, *B. oblatus* twenty-two and *B. enodis* twenty-three. This, alone, is sufficient to distinguish the species. They differ further in the azygous and regular interradial areas, and this species bears a large subcentral proboscis, while *B. oblatus* and *B. enodis* do not bear any, and *B. rotundus* bears a very small one.

Found in the Burlington Group, at Burlington, Iowa. The specimen illustrated is in the collection of A. Albers, and other specimens are in the collection of S. A. Miller.

BATOCRINUS LEVIGATUS, n. sp.

Plate I, Fig. 21, azygous side; Fig. 22, opposite view.

Species variable in size, from below medium to large. We have specimens less than half the size of the one illustrated. Vault smaller than the calyx. Calyx obconoidal and the larger specimens depressed, in the interradial areas, so as to give it a somewhat obpyramidal outline. It expands quite regularly from the column to the arms. Ambulacral orifices directed above an horizontal line and not visible in a basal view. Surface of the plates plane and smooth, some of those on the vault, sometimes, slightly convex.

Basals form an hexagonal disc about one-half wider than the diameter of the column, and bearing an hemispherical depression for its attachment. First primary radials wider than long, three hexagonal, two heptagonal. Second primary radials quadrangular, two or three times as wide as long. Third primary radials a little larger than the second, pentagonal, axillary, and, in the ray opposite the azygous area, bear upon each upper sloping side four secondary radials, which gives to this ray two arms. In the ray on the right of the azygous area, the third primary radial supports upon each upper sloping side two secondary radials, the last being axillary, and supporting on the distal sides three tertiary radials, and on the proximal sides two tertiary radials, which arrangement gives to this ray four arms. In the ray on the left of the azygous area (we speak of the right and left sides of a specimen as seen in the illustrations, without reference to the anterior and posterior sides), the distal side bears three secondary radials, the last being axillary, and supporting on each upper side two tertiary radials; and the proximal side bears two secondary radials, the last being axillary, and supporting on each upper sloping side three tertiary radials, which arrangement gives to this ray four arms. In the right lateral ray, the third primary radial bears upon each superior sloping side three secondary radials, the last ones being axillary, and one of them supporting upon each upper side two tertiary radials, and the other one supporting upon each upper side three tertiary radials, which arrangement gives to this ray four arms. In the left lateral ray, the third primary radial bears upon one upper sloping side three secondary radials, and, upon the other, two secondary radials, the last ones being axillary, and supporting on each upper side two tertiary radials, which gives to this ray four arms. There are, therefore, eighteen arms and eighteen ambulacral openings to the vault in this species. The arm formula is 4+4+2+4+4. The irregularity of the radial series is very remarkable, and yet the calyx is as symmetrical as it is in many other species, and the same features occur in several specimens.

The interradial areas are different, but they are all cut off from the vault. In the area, on each side of the azygous area, there are three plates, one followed by two, in the second range. In each of the other areas there are four plates, one in the first range, two in the second range, and an elongated plate in the third range. In the azygous area there are eight plates. The first plate is in line with the first primary radials and nearly as large. It is followed by three plates in the second range, three in the third range and one in the fourth range, which is cut off, at a distance from the vault, by the union of the tertiary radials.

Vault highly convex or obconoidal, with slightly concave depressions toward the interradial areas. It is covered with smooth, polygonal plates, some of which are convex, and bears a subcentral proboscis. The ambulacral openings are visible in a summit view. No ovarian pores discovered.

This species is essentially different, in its structure and general form, from all other eighteen-armed species, and agrees with *B. levis*, only, in the fact that they both have smooth plates and bear eighteen arms. *B. levis* has no proboscis, this species has one, the form of calyx and vault is different and the structure of the radial series above the third primary radials is different, in the two species, as well as the regular and azygous areas. The two species cannot be mistaken for each other. It is hardly necessary to compare it with any other described species. It belongs to a long list of species having smooth or finely granular plates, but that is a feature of minor importance.

Found in the Burlington Group, at Burlington, Iowa. The specimen illustrated is in the collection of Mr. A. Albers; others are in the collection of S. A. Miller.

BATOCRINUS POLITUS, n. sp.

Plate I, Fig. 23, basal view; Fig. 24, azygous side; Fig, 25, summit view.

Species small, subglobose, vault not as large as the calyx, longitudinally constricted, on the azygous side. Calyx saucer shaped. Surface of the plates plane and smooth.

Basals form an hexagonal disc, with slightly re-entering angles, about twice as wide as the diameter of the column, and having an hemispherical depression for the insertion of the column. First primary radials nearly as long as wide, three hexagonal, two heptagonal. Second primary radials quadrangular, about twice as wide as long. Third primary radials a little larger than the second, pentagonal, axillary, and, in three of the rays, support, on each upper sloping side, two secondary radials, which gives to each of these rays two arms. In the ray on the left of the azygous area, the third primary radial bears upon the proximal side two secondary radials and upon the distal side a single secondary radial, which is axillary and supports, on each upper side, a tertiary radial, which arrangement gives to this ray three arms. In the ray on the right of the azygous area, the third primary radial supports, on the distal side, a secondary radial, which is axillary, and bears upon each upper side a tertiary radial; and on the proximal side two tertiary radials, the last one being axillary and supporting, upon one upper side, an arm, and upon the other a tertiary radial, which arrangement gives to this ray four arms. There are, therefore, thirteen arms in this species. The arm formula is 4+2+2+2+3.

There is only a single plate in each regular interradial area, and it is cut off from the vault by the secondary radials. In the azygous area there are five plates. The first one is in line with the first primary radials, longer and fully as large as either of them. It is followed by three plates, in the second range, the middle one of which is the smallest and much elongated. There is one elongated plate in the third range that rests upon the plate on the left of the second range and separates the middle plate, in the second range, from the secondary radials on the left, and extends up between the secondary radials and unites with the plates of the vault.

Vault highly convex, covered with rather large, polygonal, plain, smooth plates, and bearing a small, subcentral proboscis. The ambulacral openings are directed a little above a horizontal line, and may be seen in a summit view. No ovarian pores discovered.

This species bears little or no resemblance, in general form or surface features, to *B. hodgsoni*, the only thirteen-armed species heretofore described, and cannot be mistaken for it. Its nearest affinity seems to be with *B. dodecadactylus*, Meek & Worthen, from which it is distinguished by having thirteen instead of twelve ambulacral openings to the vault, and one more secondary radial in one of the rays. This alone is sufficient to distinguish it as a species. It has also an extra, elongated plate, constituting the third range in the azygous area, that does not exist in *B. dodecadactylus*. There are minor features in which they differ, but these constitute the essential differences. In describing *B. dodecadactylus*, in Geo. Sur., Ill., Vol. II, p. 205, the third radials are described as "*hexagonal.*" This is an accidental mistake, or typographical error, for they are all pentagonal in that species and in this one.

Found in the Burlington Group, at Burlington, Iowa, and now in the collection of S. A. Miller. It also occurs at Sagetown, Illinois, and is in the collection of F. A. Sampson, from that place.

BATOCRINUS GLABER, n. sp.

Plate I, Fig. 26, azygous view of a medium specimen; Fig. 27, opposite view of same; Fig. 28, opposite view of a large specimen.

Species varying in size from small to very large. Fig. 28 represents one of the largest specimens. Fig. 26 represents a medium-sized specimen. Others, among a collection of thirty specimens belonging to this species are not more than half as large as the medium-sized specimens. The vault is usually as long or longer than the calyx, but having somewhat less capacity. The calyx is somewhat saucer-shaped, constricted broadly at the first radials and rapidly rounding up to the ambulacral openings, which are directed upward at an angle of about forty-five degrees and are not visible in a basal view. Surface of the plates plain and smooth, occasionally the larger plates may show a slight convexity.

Basals form an hexagonal disc about one half wider than the diameter of the column, and bear a concave depression less than hemispherical, for its attachment. First primary radials wider than long and transversely concave, so as to give the appearance of a constriction of the calyx, at this place. Second primary radials quadrangular, two or three times as wide as long. Third primary radials a little larger than the second, three hexagonal and two heptagonal, axillary, and bear upon each of the two superior sides two secondary radials, the last ones being axillary and supporting, on each upper sloping side, two tertiary radials, which arrangement gives to each of the rays four arms. There are, therefore, twenty arms and twenty ambulacral openings to the vault, in this species. The arm formula is 4+4+4+4+4.

The regular interradial areas are quite different from each other. In one of the areas there are three plates, one, followed by two in the second range, which are cut off from the vault by the union of the first and second tertiary radials above them. In each of the other three regular interradial areas, there are four plates, one, followed by two in the second range, and by one in the third range, but the plates are more elongated in some of these areas than in others. In the largest specimens there is an additional plate in the third range, so that there are five plates in some of the areas and four in others. In the azygous area there are twelve plates. The first one is in line with the first primary radials and nearly as large. It is followed by three plates in the second range, four in the third range, three in the fourth range and one in the fifth range that separates the last tertiary radials. There is some difference in the plates, in the azygous areas, in different specimens, above the second range of plates, and the number in the areas seems to vary from eleven to thirteen. This is a feature that is noticeable in other species of *Batocrinus*, and it may be laid down as a rule that the number of azygous plates may vary, in the same species, but the number of ambulacral openings will not change, within the limits of a species, except as a result of injury or abnormal developments.

Vault conoidal and bearing a subcentral proboscis. It is covered with plain, smooth, polygonal plates. The ambulacral openings are directed above an horizontal line and are visible in a summit view. No ovarian pores have been discovered.

This species is essentially different in its structure and general form from all other twenty-armed species, and no comparison with any of them would tend to throw any light upon it. It is a species, however, that has been frequently mistaken for *B. rotundus*, just as *B. oblatus* and all other smooth species of *Batocrinus* have been. *B. rotundus*, as originally defined and illustrated, is a twenty-one-armed species. It is much smaller, as a general rule, than this species and never attains the size of the specimens illustrated, in figure 28, though it has one more arm, in the radial series. It never agrees in form with this species, nor does it possess as large a probocis. It is not constricted around the first primary radials, as this species is, nor does it possess the same form and number of plates in the azygous and regular interradial areas. The resemblance between the two species is more fanciful than real. The error probably arose in this way, Meek & Worthen, in describing *B. dodecadactylus*, (Geo. Sur. Ill. Vol. 2, p. 207), say: "Knowing that the number of arms sometimes varies to some extent, in different specimen of the same species of crinoids, we were at first inclined to think the form under consideration might be only a young specimens of *A. rotundus*, but on comparing it carefully with specimens of that species of the same size, we find they possess the usual number of arms (20) in all our specimens, and uniformly present the other differences mentioned." In writing the description of *B. dodecadactylus*, Meek did not have a single specimen of *B. rotundus* before him, but he had numerous specimens of this species, some of them as small as the species he was describing, and he had mistaken them for *B. rotundus*. In other publications, we find *B. rotundus* mentioned as twenty-armed species, and like other errors, when put in circulation it continues, because all authors do not take the time to correct it. Yandell & Shumard described and illustrated in the Geo. Sur. of Mo. a twenty-one-armed species under the name of *Actinocrinus rotundus*, now known as *Batocrinus rotundus*, which is a species very rare, in comparison with this species, at Burlington and the Illinois localities and when this species was confounded with it, the species was supposed to be very common, because two were included under one name. The statement, that "the number of arms sometimes varies to some extent, in different specimens of the same species of crinoids," we think is quite a mistake, if it refers to variations of the rays within the calyx, which we think never take place, except as a result of injury, and, therefore, of abnormal development. If crinoids vary to "some extent," in this respect, in the same species, they may vary to a greater extent and all the species may be thrown into one, under any particular genus. This erroneous view seems to have been entertained by several of the earlier authors when they described the crinoids, by the ring of the plates, commencing at the basals and going upward, and of course placing less and less value upon each succeeding ring, and it has been perpetuated, especially among those who have never given the subject much attention. Prof. James Hall was correct in laying the stress he did upon the arm formula, as our study and observation has led us to believe.

The specimens illustrated are from the Burlington Group, at Burlington, Iowa. The large one is in the collection of Wm. F. E. Gurley, the smaller one in the collection of A. Albers. The species is numerously represented in all collections from the Burlington Group of Iowa and Illinois.

BATOCRINUS INSOLENS, n. sp.

Plate II, Fig. 1, azygous side; Fig. 2, opposite view.

Species medium or below medium size, biturbinate, calyx and vault subequal in form and capacity, and together subelliptical in outline. Calyx bowl-shaped, truncated below and rounded up toward the arms; no radial ridges; plates convex and the larger ones transversely nodose; diameter from one-third to one-half more than the height.

Basals form an hexagonal disc about one-half wider than the diameter of the column, with an hemispherical columnar cavity radiately furrowed. First radials large, about as long as wide, three hexagonal and two heptagonal. Second radials quadrangular, from two to two and a half times as wide as long. Third primary radials larger than the second, four hexagonal and one heptagonal, axillary, and, in the ray opposite the azygous area, supports on each upper sloping side, three secondary radials, which gives to this ray two arms. In the ray on the left of the azygous area, and in the left lateral ray, the third primary radials support, on each superior side, two secondary radials, the last ones of which are axillary and bear upon each superior distal side two tertiary radials, and upon each proximal side a single tertiary radial, which gives to each of these rays four arms. In the right lateral ray, the third primary radial supports, on one side, two secondary radials the last being axillary and supporting on the outer side two tertiary radials and on the inner side only one; and on the other side a single secondary radial, which supports, on the distal side, three tertiary radials, and, on the proximal side two, which gives to this ray four arms. In the ray on the right of the azygous area, the third primary radial supports, on the side adjoining the azygous area, two secondary radials, the last being axillary and supporting on each upper sloping side a single tertiary radial; and on the side distant from the azygous area three secondary radials, but two of these are upon the proximal sloping side of the first, and, upon the superior side of the first, there is an intersecondary plate, while the distal side abuts the first tertiary radial, in the adjoining ray. This is the structure of the specimen illustrated and gives to this ray only three arms, but, we think this structure is abnormal, because this intersecondary plate is in the position of a tertiary radial and because there is a plate out of place at the top of the azygous area that we will again call attention to. Beside, we have another specimen belonging to this species, that happens to be injured so as not to disclose the whole structure of the ray, but there are four ambulacral openings, and, so far as preserved, the ray is like the one on the left of the azygous area. There are, therefore, in the specimen illustrated, only seventeen arms, but we believe, from the structure and evidences above mentioned, that one of the rays has suffered from an injury that produced an abnormal ray and that the species bears eighteen arms, and that the true arm formula is 4+4+2+4+4, instead of 3+4+2+4+4. We do not wish to be understood, however, as intimating that seventeen ambulacral openings to the vault, is an abnormal condition of a crinoid, on the contrary, seventeen may as well be normal as eighteen or any other number. It is the peculiar intersecondary plate and the peculiar plate at the top of the azygous area and the evidence afforded by another injured specimen, that lead us to think the specimen illustrated is abnormal. If the ray was an ordinary three-armed ray, we would say the specimen is normal and the species has only seventeen arms, and, if another specimen constructed, on the same plan, was found bearing eighteen arms, we would say it is a distinct species. The number of ambulacral openings to the vault is of the greatest specific importance, but a crinoid, injured on any part of the body, might have been able to heal the wound, by an abnormal growth, restoration or intercalation of plates.

There are three plates, in each of three regular interradial areas, one followed by two. In the area on the right of the three-armed ray there are only two plates, one followed by another. If we are correct in supposing the specimen illustrated to be abnormal, from some injury, then the areas, probably, are all alike and have three plates, one followed by two. In the azygous area there are seven plates. The first one is in line with the first primary radials and larger than either one of them. It is followed by four plates in the second range, and two in the third range, one of which reaches the plates of the vault in the specimen illustrated. The first plate and the last plate may be abnormal in size, and the latter, to some extent, in position; for if the ray, on the right of the azygous area, in a normal condition bears four arms, then the azygous area is, probably, cut off from the vault, and the last plate shown in the illustration is much smaller than it appears to be in the specimen, and does not extend to the vault plates.

The vault is conoidal and terminates in a large subcentral proboscis. It is covered with numerous convex, polygonal plates.

This species has little or no resemblance in form to *B. cassedayannus* or *B. formaceus*, the only seventeen-armed species heretofore described, and seems to be as far removed from all eighteen-armed species, except possibly, *B. longirostris;* but it is so far removed from that species that no comparison will throw any light upon either of them.

Found in the Burlington Group, at Burlington, Iowa, and now in the collection of S. A. Miller.

BATOCRINUS SELECTUS, n. sp.

Plate II, Fig. 3, azygous side; Fig. 4, opposite view; Fig. 5, summit.

Species medium size. Calyx obconoidal, truncated only the size of the column. Plates smooth, no radial ridges. Arm openings directed upward and not visible in a basal view.

Basals form a cup about twice as wide as high. First radials the largest plates in the body, and nearly as long as wide, three hexagonal, two heptagonal. Second and third radials together much smaller than the first. Second radials quadrangular, three or four times as wide as long. Third radials a little larger than the second, pentagonal, axillary, and support upon each superior sloping side two secondary radials, the last ones being axillary and supporting upon each upper side two tertiary radials, except in the ray opposite the azygous area where the second secondary radial upon one side supports an intersecondary plate, and not an arm, which arrangement gives to this species nineteen arms. The arm formula is 4+4+3+4+4.

Regular interradial areas very unequal. One has six plates, another five, another four, and the other three. The one that has four plates has one in the first range, two in the second, and an elongated plate in the third, which reaches a vault plate. The other areas are cut off from the vault by the union of the tertiary radials. There are eleven plates in the azygous area. The first one is in line with the first primary radials, but somewhat smaller. It is followed by three plates in the second range, and five in the third range, the middle one being much the largest. There is one small plate on the right of the latter. The middle plate in the third range unites with an elongated plate that separates the tertiary radials and extends over upon the vault.

Vault depressed convex, covered with smooth, polygonal plates, and bears a subcentral proboscis. No ovarian pores.

The form of this species is altogether different from other nineteen-armed species, and cannot be mistaken for any other species.

Found in the Burlington Group, at Sagetown, Illinois, and now in the collection of Wm. F. E. Gurley.

BATOCRINUS ALBERSI, n. sp.

Plate II, Fig. 6, azygous side having the basal plates broken away; Fig. 7, basal view; Fig. 8, summit.

Species above medium size, trochiform. Calyx abruptly spreading, almost horizontally, from the region of the second and third primary radials. Surface of the plates plane and smooth, and generally very large, and the last radials project beyond the summit plates.

Basals broken away from our specimen. First primary radials longer than wide, three hexagonal, two heptagonal. Second and third primary radials together much smaller than the first. Second primary radials quadrangular, between two and three times as wide as long. Third primary radials a little larger than the second, four pentagonal, one hexagonal, axillary, and in the ray, on each side of the azygous area, support, on each upper sloping side, two secondary radials, the last being axillary, and supporting, on each upper sloping side, a single tertiary radial, except on one side where there are two, which gives to each of these rays four arms. In one of the lateral rays, the third primary radial supports, upon each upper side, two secondary radials, the last one, upon one side, being axillary, and supporting, upon each upper side, a tertiary radial, and the last one, on the other side, supporting, on one side, a tertiary radial, and upon the other, a free arm, which gives to this ray four arms. In the other lateral ray and in the ray opposite the azygous area, the third primary radials support, on one side, three secondary radials, and upon the other side, two secondary radials, the last one being axillary, and supporting, on each upper side, a tertiary radial, which arrangement gives to each of these rays three arms. There are, therefore, eighteen arms in this species. The arm formula is 4+3+3+4+4.

In each of two of the regular interradial areas there are two plates, one following the other. In each of the other two regular interradial areas, there are three plates, one followed by two, in the second range. In the azygous area there are seven plates. The first one is in line with the first primary radials and of about the same size. It is followed by three plates, in the second range, and by three plates, in the third range, which are cut off from connection with the plates of the vault by the union of the tertiary radials.

The vault is moderately convex and bears a large central proboscis. The interambulacral areas are concave and covered with smaller plates than those over the ambulacral canals. The plates are polygonal, quite variable in size, the smaller ones convex and the larger ones tumid. The ambulacral openings are visible in a summit view, but cannot be seen from a basal view, though they seem to be directed nearly horizontally. No ovarian pores discovered.

This species bears little or no resemblance, in form or surface ornamentation, to any other described eighteen-armed species. The calyx has some resemblance to that of *B. christyi*, which is a twenty-armed species, but, probably, looks more like *B inornatus*, another twenty-armed species, than to any other defined species. It is so widely separated from these, however, that no comparison is necessary for any purpose.

Found in the Burlington Group, at Burlington, Iowa. The specific name is in honor of Mr. A. Albers, the artist, and the type belongs to his collection.

BATOCRINUS SACCELLUS, n. sp.

Plate II, Fig. 9, azygous side; Fig. 10, opposite view; Fig. 11 summit.

Species medium or above medium size. Calyx urn-shaped, a little wider than high. Plates convex; no radial ridges. Sutures beveled. Surface granular.

Basals form a low hexagonal cup with beveled sutures and an hemispherical depression for the attachment of the column. The diameter is three times the height or twice the diameter of the column. The first primary radials are the largest plates in the body, and are nearly as long as wide. They are about as large as the second and third plates together. Three hexagonal and two heptagonal. Second primary radials quadrangular and from two to three times as wide as long. Third primary radials a little larger than the second, each one is heptagonal and supports on each of two of the upper sides, in four of the rays, two secondary radials the last ones of which are axillary and support, on each proximal upper side, a single tertiary radial, and on each distal side, two tertiary radials, which give to each of these rays four arms. In the ray opposite the azygous area, the third primary radial bears on one upper sloping side, three secondary radials, and upon the other, two secondary radials, the last being axillary and supporting, on each upper side a single tertiary radial, which gives to this ray three arms. There are, therefore, nineteen arms, in this species. The arm formula is 4+4+3+4+4.

The interradial areas are very differrent from each other; in each of the two areas there are four plates, one in the first range, two in the second and one in the third. In each of the other areas, there are five plates; in one of them there are three plates, in the second range, and one in the third, and in the other there are two plates, in the second range, and two in the third. There are thirteen plates in the azygous area. The first one is in line with the first primary radials and about as large. It is followed by three plates in the second range, six plates in the third range, three plates in the fourth range, the middle one of which unites with a plate on the vault, and a small plate in the fifth range also unites with the plates of the vault. The plates in the regular areas are all distinctly cut off from the plates of the vault, except in one area, where a plate in third range extends an angle to a vault plate.

The vault is elevated abruptly over the ambulacral openings, and depressed convex toward the center, where it bears a strong proboscis. The interambulacral areas are depressed toward the margin. The plates are polygonal, convex, and some of the larger ones bear a central node. The arm openings are directed upward, at an angle of about forty-five degrees, and are not visible in a basal view. No ovarian pores have been discovered.

This species bears very little resemblance to any other nineteen-armed species and may have its nearest affinity with *B. longirostris*, a twenty-armed species. It has a different form, however, and a differently constructed vault, and differs widely in the regular and azygous areas, as well as being larger and having only nineteen arms. It cannot be mistaken for any other species.

Found in the Burlington Group, at Burlington, Iowa, and now in the collection of Wm. F. E. Gurley.

BATOCRINUS SUBLEVIS, n. sp.

Plate II, Fig. 12, azygous side; Fig. 13, opposite view; Fig. 14, summit.

Species large, somewhat biturbinate. Calyx truncated only the size of the column, broadly constricted in the region of the first primary radials, and rounding up toward the arm openings, which are directed upward and are not visible from a basal view. One-half or more than one-half wider than high. No radial ridges. Surface plain and smooth.

Basals form a low cup, about two and a half times as wide as high, which bears a hemispherical depression for the attachment of the column. First primary radials transversely concave, large, wider than long, three hexagonal and two heptagonal. Second primary radials quadrangular, about twice as wide as long. Third primary radials about one-half larger than the second, three heptagonal and two hexagonal, and bear upon each of two of the superior sides two secondary radials, the last ones of which are axillary and, in four of the rays, support on each upper side two tertiary radials, which gives to each of these rays four arms. In the ray on the right side of the azygous area the distal secondary radial bears, upon each upper side, two tertiary radials, and the proximal secondary radial bears, upon one side, two tertiary radials and upon the other a single tertiary radial, which is axillary and bears, upon each upper side, a single quaternary radial, which arrangement gives to this ray five arms. There are, therefore, twenty-one arms in this species. The arm formula is 5+4+4+4+4.

In each regular interradial area there are six plates. One in the first range, two in the second, two in the third and one in the fourth, all of which are cut off from any connection with the vault, by the union of the tertiary radials. In the azygous area there are twenty-one plates. The first is in line with the first primary radials and of about the same size. It is followed by three plates in the second range, five plates in the third range, six plates in the fourth, and above these there are five small plates and one elongated plate that extends up to and unites with two plates belonging to the vault.

The vault is subconoidal and covered with irregular, polygonal plates, and bears a very large, subcentral broboscis. The plates are plain and smooth, except the large plate opposite to the azygous side of the proboscis, which is convex. The arm openings are directed upward. No ovarian pores discovered.

This species cannot be compared with any other twenty-one armed species, unless it is with *B. rotundus*, and here there is very little resemblance. The form of the calyx is different; there is no constriction in *B. rotundus*. The vault and proboscis are altogether different, in every respect. This species has twice as many regular interradials and twice as many azygous plates, and the areas are altogether different. It agrees with *B. glaber*, which is a twenty-armed species, only in the smooth plates and the constriction at the first primary radials. It is quite unnecessary to make further comparisons, for it cannot be mistaken for any other species, where there is the slightest capacity for observatior.

Found in the Burlington Group, at Sagetown, Illinois, and now in the collection of Wm. F. E. Gurley.

BATOCRINUS REMOTUS, n. sp.

Plate II, Fig. 15, azygous side; Fig. 16, opposite view; Fig. 17, summit.

Species medium size. Calyx obconoidal, a little wider than high, truncated only the diameter of the column. Ambulacral openings directed only slightly above a horizontal line, but not visible either in a basal or summit view. No radial ridges. Surface of the plates plain and smooth. Column round and composed of rather thick plates.

Basals form an obconical cup twice as wide as high. First primary radials one-half larger than the second and third together, nearly as long as wide, three hexagonal, two heptagonal. Second primary radials quadrangular, about twice as wide as long. Third primary radials very little larger than the second, pentagonal, axillary, and support, on each upper sloping side, two secondary radials, the last ones of which are axillary, and, in three of the rays, support, on each proximal side, a single tertiary radial, and upon each distal side, two tertiary radials, which gives to each of these rays four arms. In each ray adjoining the azygous area, the structure is the same, except the secondary radials bear upon each of the sides abutting the area a single tertiary radial, which is axillary, and supports, upon each upper side, a quaternary plate, which arrangement gives to each of these rays five arms. There are, therefore, twenty-two arms in this species. The arm formula is 5+4+4+4+5.

In each regular interradial area there are two plates, one followed by another, that does not extend to the vault. In the azygous area there are eight plates. The first one is in line with the first primary radials and rather larger than either of them It is followed by four plates, in the second range, and by three plates, in the third range, which are cut off from the plates of the vault by the union of the quaternary plates above them.

The vault is covered with polygonal, convex plates, and bears a large, subcentral proboscis. It is elevated over the ambulacral openings and convex toward the proboscis, except a concave interambulacral depression on the azygous side. No ovarian pores discovered.

This species evidently has its nearest affinity with *Batocrinus turbinatus* and *Batocrinus turbinatus var. elegans*, with which it agrees, in the radial series. In *B. turbinatus*, the basal plates are thick, short, and form a distinct rim projecting over the column, and in the *var. elegans* the basal plates are squarely truncate below, and indented at the sutures. In this species the basal plates form an obconoidal cup entirely covered below by the end of the column. In the regular interradial areas, in *B. turbinatus* and in the *var. elegans*, there are three ranges of interradials, the last plate, in *B. turbinatus*, lying near the bases of the arms. In this species there are only two ranges of interradials and they are cut off from the arm bases by the union of the two series of tertiary radials above them. In *B. turbinatus* and in the *var. elegans*, there are only three plates, in the second range, in the azygous area, and, in this species, there are four plates. In *B. turbinatus* there are ten azygous plates, and the last ones separate the arm bases and unite with the plates of the vault. In this species there are only eight azygous plates and they are cut off from the vault by the union of the quaternary plates above them. There are important differences in the structure of the vault and minor variations might be pointed out, but the general expression of the species will always distinguish them; and, unless we wholly set aside any importance to the structure of the regular and azygous areas, intermediate forms cannot bring these forms into a single species, though the arm formulas bring them to a close relationship.

Found in the Burlington Group, at Burlington, Iowa and now in the collection of S. A. Miller.

BATOCRINUS REPOSITUS, n. sp.

Plate II, Fig. 18, azygous side; Fig. 19, opposite view; Fig. 20, summit.

Species medium size. Calyx obconoidal, nearly as high as wide, truncated only for a small column; last radials project laterally, while the interradial spaces are depressed and the ambulacral openings become invisible from a basal view. No radial ridges. Surface of the plates plain and smooth. Column small and round.

Basals form a conical cup, having a height nearly equal to the diameter, and it is truncated below by a small column. First primary radials not as large as the basals, wider than long, three hexagonal, two heptagonal. Second primary radials quadrangular, from two to three times as wide as long. Third primary radials a little larger than the second, one heptagonal, three hexagonal, one pentagonal, axillary, and in each of the rays, adjoining the azygous area, support on each upper sloping side two secondary radials, the last ones of which support, on each upper sloping side a single tertiary radial, except the distal one on the left, which bears an ambulacral opening on one side of the secondary radial and on the other a tertiary radial. The arrangement, however, gives to each of these rays four arms. In one of the lateral rays the third primary radial supports, upon each upper side, two secondary radials, the last ones having an ambulacral opening on each proximal side, and a tertiary radial on each distal side, which gives to this ray four arms. In the other lateral ray the structure is the same, except that one of the secondary radials does not bear a tertiary plate, but it supports two ambulacral openings, so that the ray has four arms. In the ray opposite the azygous area, the third primary radial supports, on one side, two secondary radials, the last one being axillary and supporting on each side a tertiary radial, and on the other side two secondary radials, the last one having a single ambulacral opening, which gives to this ray three arms. There are, therefore, nineteen arms in this species. The arm formula is 4+4+3+4+4.

The interradial areas are remarkable. The first one to the right of the azygous area has four plates, one in the first range, and two large, elongated plates in the second range, one of which, and a small plate at the side of the top of it, unite with two plates belonging to the vault. The lateral area, on the same side, has three plates, one in the first range and two in the second, but they do not connect with the vault. The area opposite the azygous area has six plates, one in the first range, two in the second and three in the third, the middle one of which is large and elongated and extends over upon the vault. The other lateral area has five plates, one in the first range, two in the second and two in the third, which unite with two plates belonging to the vault. There is one intersecondary plate in the area to the right of the azygous area, and also in the opposite area, that unites with the plates of the vault. In the other intersecondary areas a vault plate curves down between the arm bases and unites with the secondary radials. In the azygous area there are eleven plates. The first one is in line with the first primary radials and quite as large. It is followed by three plates in the second range, four in the third range, above which there are three plates, the middle one passing up between the arm bases and uniting with the plates of the vault.

The vault is gently convex, covered with large and small polygonal plates, and bears a subcentral azygous orifice. The arm openings are directed upward. No ovarian pores discovered.

This is a remarkable species, and will not be mistaken for any other. The vault and interradial and intersecondary areas are peculiar, but the arm structure is the most extraordinary. The secondary radials that are half axillary, or bear a free arm on one side and a tertiary radial on the other, is a feature of rare occurrence, but it is certainly not abnormal. *Batocrinus bisbrachiatus*, Whitfield, of which we have several specimens, bears two free arms on each of the last radials, without the presence of the usual axillary plate, so that it is much farther removed from the ordinary arm structure than is this species.

Found in the Burlington Group, at Burlington, Iowa, and now in the collection of A. Albers.

BATOCRINUS ENODATUS, n. sp.

Plate II, Fig. 21, azygous side; Fig. 22, basal view; Fig. 23, summit.

Species small, subglobose, vault as large as the calyx, longitudinally constructed on the azygous side. Calyx saucer shaped. Surface of the plates plane and smooth.

Basals form an hexagonal disc, with slightly re-entering angles, more than twice as wide as the diameter of the column and having a concave depression for the attachment of the column. First primary radials wider than long, three hexagonal, two heptagonal. Second primary radials quadrangular, two or three times as wide as long. Third primary radials about one-half larger than the second, pentagonal, axillary, and in the ray, on each side of the azygous area, support, on each sloping side, a single secondary radial, which is axillary and supports, on each superior side, a tertiary radial, which gives to each of these rays four arms. In each of the other three rays the third primary radial supports, on each upper side, a single, large, secondary radial, which gives to each of these rays two arms. There are, therefore, fourteen ambulacral openings to the vault in this species. The arm formula is 4+2+2+2+4.

There is only a single plate in each regular interradial area, and it is cut off from the vault by the union of the secondary radials. In the azygous area there are four plates. The first one is in line with the first primary radials and somewhat smaller than either of them. It is followed by three plates in the second range, the middle one of which unites with an elongated plate that belongs to the plates of the vault.

Vault highly convex, covered with rather large, polygonal, plane, smooth plates, and bears a subcentral, azygous orifice, without a proboscis. Ambulacral openings directed above an horizontal line and not visible in a basal view. No ovarian pores discovered.

This species bears no resemblance, in form or surface ornamentation, to any other fourteen-armed species. It would seem to have the nearest affinity with *B. politus*, from which it is distinguished by having only one secondary radial instead of two, by having fourteen arms instead of thirteen, by having no proboscis, and other minor differences.

Found in the Burlington Group, at Sagetown, Illinois, and several specimens are in the collection of F. A. Sampson.

BATOCRINUS SPECIOSUS, n. sp.

Plate II, Fig. 24, azygous side; Fig. 25, opposite view; Fig. 26, summit.

Species medium size, biturbinate. Calyx obpyramidal, moderately truncated below, slightly constricted at the top of the basal disc, most rapidly spreading at the base of the arms, more than one-half wider than high. Radial ridges present. Surface of interradials smooth. Arm openings directed nearly horizontally.

Basals short, upright, and form an hexagonal disc. First primary radials the largest plates in the calyx, about as long as wide, three hexagonal, two heptagonal, and each one bears a small, central, transverse node. The constriction at the top of the basal disc involves the lower part of the first radials. Second primary radials quadrangular, two or three times as wide as long. Third primary radials hexagonal or heptagonal, about one-half larger than the second, axillary, and, in the ray opposite the azygous area, supports on each upper sloping side three secondary radials, which gives to this ray two arms. In each of the other four rays the third primary radial supports, on each upper sloping side, two secondary radials, the last ones being axillary and supporting on each upper sloping side two secondary radials, which gives to each of these rays four arms. There are, therefore, eighteen arms in this species. The arm formula is 4+4+2+4+4. The interradial areas do not connect with the vault. In each regular interradial area there are three plates, one followed by two in the second range. In the azygous area there are seven plates. The first one is in line with the first primary radials and nearly as large as one of them. It is followed by three plates in the second range and three in the third, which are cut off from the vault by the union of the tertiary radials above them.

The vault is elevated over the ambulacral openings, highly convex, with slightly depressed interambulacral areas. It is covered with polygonal, convex plates, and bears a subcentral proboscis.

This is a handsome species, so different from all other eighteen-armed species from the Burlington Group, that no comparison with any of them is necessary.

Found in the Burlington Group, at Burlington, Iowa, and now in the collection of Mr. A. Albers.

BATOCRINUS SUBROTUNDUS, n. sp.

Plate II, Fig. 27, basal view; Fig. 28, summit; Fig. 29; azygous side.

The general form is depressed—rotund. The vault being as large or larger than the calyx, and both slightly depressed longitudinally at the margin at the top of the azygous area. Calyx broadly saucer-shaped. No radial ridges. Arm openings directed above an horizontal line and not visible in a basal view. Surface plain and smooth.

Basals expanded and forming a shallow, hexagonal disc, about twice as wide as the diameter of the column and bearing an hemispherical depression for the attachment of the column. First primary radials from one-half wider to twice as wide as long, three hexagonal and two heptagonal. Second primary radials quadrangular, about three times as wide as long. Third primary radials as small as the second, pentagonal, axillary, and in the ray on the right of the azygous area supports on each upper sloping side two secondary radials, the last ones being axillary and supporting on each proximal side two tertiary radials and on each distal side a single, axillary, tertiary radial which supports on each upper side a quaternary radial, which arrangement gives to this ray six arms. In the ray, on the left of the azygous area, the third primary radial supports on each upper sloping side a single, axillary, secondary radial, which bears on each proximal side two tertiary radials and on each distal side two tertiary radials, the last ones being axillary and supporting, on each upper sloping side, a quaternary radial, which gives to this ray six arms. In the ray opposite the azygous area, the third primary radial bears, upon one side, two secondary radials, the last being axillary and supporting, on each upper side, two tertiary radials, and upon the other side, a single secondary radial, which is axillary and supports, on one side, two tertiary radials, and, upon the other, three tertiary radials, which gives to this ray four arms. One of the lateral rays is constructed in the same way and has four arms. The other lateral ray bears upon each upper side of the third primary radial two secondary radials, the last ones being axillary and supporting, on each upper sloping side, two tertiary radials, which gives to it four arms. There are, therefore, twenty-four arms in this species. The arm formula is 6+4+4+4+6.

The regular interradial areas differ from each other, but none of them connect with the plates of the vault. In each of two areas there are three plates, one followed by two in the second range. In another area there are four plates, one followed by two in the second range, and one in the third range. In the other area there are five plates, one followed by two in the second range, one in the third range and one in the fourth range. There are nine plates in the azygous area. The first one is in line with the first primary radials, and rather larger than either of them. It is followed by four plates in the second range, and three in the third range, above which there is a single plate that separates the quaternary radials and unites with the plates belonging to the vault.

The vault is very evenly convex and bears a subcentral azygous orifice. No proboscis. It is covered with plane, smooth, polygonal plates. No ovarian pores discovered.

This species bears no resemblance in form to either of the twenty-four-armed species heretofore described. It would be classed with the rotund forms having smooth plates and no proboscis and ranging from *B. dodecadactylus* with twelve arms to the present species.

Found in the Burlington Group, at Burlington, Iowa, and now in the collection of A. Albers.

BATOCRINUS SUBOVATUS, n. sp.

Plate II, Fig. 30, azygous side; Fig. 31, opposite view.

Species medium size, and general form rotund or subovate; calyx and vault subequal in size. No radial ridges. Plates plane and smooth. Arm openings directed above an horizontal line and not visible in a basal view.

Basals form an hexagonal disc a little larger than the diameter of the column, which bears a concave depression for the attachment of the column. First primary radials about one half wider than high, three hexagonal, two heptagonal. Second primary radials quadrangular, two or three times as wide as long. Third primary radials a little larger than the second, pentagonal, axillary, and the ray on the right of the azygous area bears upon each superior sloping side two secondary radials, the last being axillary, and one of which bears upon each upper face two tertiary radials, and the other bears upon the distal side, two tertiary radials, and upon the proximal side, one axillary, tertiary radial, which supports upon each upper side a quaternary radial, which gives to this ray five arms. In the ray on the left of the azygous area, the third primary radial bears upon each upper side, two secondary radials, the last being axillary and supporting, upon each upper side, two tertiary radials, which gives to this ray four arms. In one of the lateral rays, the third primary radial bears upon one side four secondary radials, and upon the other, three secondary radials, the last being axillary and supporting on each upper side two tertiary radials, which gives to this ray three arms. In the other lateral ray, the third primary radial supports, on one side, three secondary radials, and upon the other, one which is axillary and supports, on one side, three tertiary radials, and on the other, two tertiary radials, which gives to the ray three arms. In the ray opposite the azygous area the third primary radial supports, on each upper side, three secondary radials, which gives to it two arms. There are, therefore, seventeen arms in this species. The arm formula is 5+3+2+3+4.

The interradial areas are unequal, but all are separated from the plates of the vault. In each of two areas there are two plates, one following the other. In another area there are three plates, one followed by two in the second range. In the other area there are four plates, one followed by two in the second range, and one in the third range. There are eight plates in the azygous area. The first one is in line with the first primary radials and somewhat smaller than either of them. It is followed by three plates, in the second range, three in the third range, and one in the fourth range, which is cut off from the vault by the union of the tertiary radials above it.

The vault is highly convex and covered with plane, smooth, polygonal plates. It bears a subcentral proboscis. No ovarian pores discovered.

This species bears little resemblance to any other seventeen armed species, and, of course, need not be compared with any other; though its general appearance may be said to resemble *B. rotundus*, from which it is very widely separated in the essential elements of structure.

Found in the Burlington Group, at Burlington, Iowa, and now in the collection of A. Albers.

BATOCRINUS SUBSCITULUS, n. sp.

Plate III, Fig. 9, view opposite the azygous area; Fig. 10, basal view; Fig. 11, summit.

Species medium size, biturbinate, or somewhat wheel-shaped. Calyx two and a half times as wide as high, most rapidly spreading toward the arms, which are directed horizontally, and leaving the sides concave or a broad constriction from the basals to the arms. Surface of the plates plain and smooth.

Basals form a low expanding cup twice as wide as the diameter of the column and having an hemispherical depression for the attachment of the column. First primary radials between two and three times as wide as long, three hexagonal, two heptagonal. Second primary radials quadrangular, three or four times as wide as long. Third primary radials only a little larger than the second, three hexagonal, one heptagonal and one pentagonal, axillary, and in each of four of the rays support, on each superior sloping side, two secondary radials, the last being axillary, and supporting, on each upper side, two tertiary radials, except adjoining the azygous area there are three, which gives to each of these rays four arms. In the ray opposite the azygous area, the third primary radial bears upon each upper sloping side three secondary radials, which gives to this ray two arms. There are, therefore, eighteen arms in this species. The arm formula is 4+4+2+4+4.

In each regular interradial area there are three plates, one wide, short plate, followed by two in the second range. In the azygous area there are seven plates. The first one is in line with the first primary radials and about the same size. It is followed by three plates, the middle one being short and very wide; above these upon the right there are three small plates, in the third range. The azygous and interradial areas are widely separated from the plates of the vault.

The vault is convex and covered with large, polygonal, tumid plates. It bears a subcentral proboscis.

This species is so readily distinguished by its general form and surface characters from all other eighteen-armed species that no comparison is necessary with any of them.

Found by R. A. Blair in the Burlington Group, at Sedalia, Missouri, and now in the collection of S. A. Miller.

BATOCRINUS RUDIS, n. sp.

Plate IV, Fig. 4, azygous side view.

Species large, biturbinate. Calyx about one-half wider than high, most rapidly spreading in the superior part, so as to leave the sides arcuate or apparently broadly constricted from the basals to the free arms. Ambulacral openings directed horizontally and not visible in a basal or summit view. Plates tumid and nodose. No radial ridges.

Basals the largest plates in the body, flattened on the outside and extended in expanding wedge-shaped ends below the end of the column. They form an hexagonal cup, about twice as wide as the diameter of the column, with widely gaping sutures below, so that the calyx will stand on the cuneiform edges of the basal plates. First primary radials wider than long, three hexagonal, two heptagonal, and each one bears a transverse central node. Second primary radials quadrangular about one-half or less than one-half wider than long and each one bears a central node. Third primary radials of unequal size, the one on the right of the azygous area is large and heptagonal, the one on the left of the azygous area is small and hexagonal, the others are pentagonal or hexagonal, axillary, and support, on each upper sloping side, two secondary radials, the last being axillary, and supporting, upon each upper sloping side, two tertiary radials, except on each side adjoining the azygous area, where there is only a single secondary radial, which is axillary, and bears upon each superior sloping side three tertiary radials, which arrangement gives to each ray four ambulacral openings to the vault. There are, therefore, twenty arms and twenty ambulacral openings to the vault in this species.

The regular interradial areas are widely separated from the plates of the vault, and in the areas that can be determined in our specimen there are three plates, one, followed by two small ones in the second range. In the azygous area there are seven nodose plates. The first one is in line with the first primary radials and larger than either of them. It is followed by three plates in the second range, two in the third range, and one in the fourth range that unites with an elongated plate belonging to the vault.

The vault is highly convex or conoidal and has a capacity fully equal to that of the calyx. It is covered with very tumid and nodose plates, and bears a very large central proboscis.

This species is readily distinguished by its form and nodose plates from all others that have been described, among the twenty-armed species. Probably it is as near *B. honorabilis* as any other, but there are more tertiary radials in that species than in this one, and the ambulacral openings are directed upward instead of horizontally. The interradial areas are more elongated and have more ranges of plates than there are in this species, and the azygous area is is not connected with the vault in that species as it is in this. The vault is much more conoidal in this species than in that, and has a much larger proboscis. The two species are so dissimilar that they are readily distinguished.

Found in the Keokuk Group, on Little Barren river, Kentucky, and now in the collection of Charles L. Faber.

BATOCRINUS SAGETOWNENSIS, n. sp.

Plate IV, Fig. 5, azygous side; Fig. 6, opposite view; Fig. 7, summit.

Species large, somewhat urn-shaped. Calyx somewhat obconoidal, nearly as long as wide, broadly truncated, constricted above the basals, lobed in the superior radial regions. Plates convex, the larger ones nodose. Ambulacral openings directed upwards and not visible in a basal view.

Basal plates the largest in the body, and form a cup about twice as wide as high and about twice as wide as the diameter of the column. They extend below the end of the column and are constricted in the upper part. First primary radials large, longer than wide, three hexagonal, two heptagonal, and each one bears a transverse central node. Second primary radials quadrangular, about one-half wider than long. Third primary radials a little larger than the second, pentagonal, axillary, and support, on each upper sloping side, two large, secondary radials, the last being axillary and supporting, on each upper sloping side, a single, large tertiary radial, which arrangement gives to each ray four ambulacral openings to the vault. There are, therefore, twenty ambulacral openings to the vault in this species.

All of the interradial areas connect with the plates of the vault. The regular interradial areas are elongated, of uneqal size, and contracted toward the superior part. The first plate in each of the areas is large and nodose. In one area there are two plates in the second range, one in the third range, and one in the fourth range, which unites with a single plate belonging to the vault. In another area there are two elongated plates, in the second range, that unite with two elongated plates, that curve over upon the vault. In another area there are two plates, in the second range, that unite with two plates, in the third range, that unite with two plates belonging to the vault. The other area has the same number of plates that are in the first area, above described, and they are arranged in nearly the same order, dut differ in size. There are eleven plates in the azygous area. The first one is in line with the first primary radials, and of about the same size and equally as nodose. It is followed by three plates, subequal in size, in the second range. In the third range there are four plates, one of which is quite small and quadrangular, and above it and in line with the upper part of the largest plate, in the third range, there is a single plate. Above the last two plates there are two elongated plates that unite with the plates of the vault.

The vault recedes from the ambulacral openings with slight convexity, and then rapidly rises cone-like, which is continued slightly, subcentrally, in a large proboscis. The vault is covered with polygonal, convex plates, the larger ones being nodose. The ambulacral openings are above the calyx, on the flattened margin of the vault, and are directed straight upward.

This is a peculiar species, so different in its general appearance and structure from all other twenty-armed species, that no comparison with any of them is necessary to distinguish it.

Found in the Burlington Group, at Sagetown, Illinois, and now in the collection of Wm. F. E. Gurley.

BATOCRINUS AFFINIS, n. sp.

Plate IV, Fig. 8, azygous view; Fig. 9, opposite view.

Species small, somewhat biturbinate. Calyx obconoidal, truncated, nearly as high as wide. No radial ridges. First primary radials and interradials nodose. A small ovarian pore by the side of each ambulacral opening. Ambulacral openings directed horizontally.

Basals form an hexagonal cup four times as wide as high, twice as wide as the diameter of the column, slightly constricted in the upper part, and having an hemispherical depression for the attachment of the column, and a minute, round columnar canal. First primary radials longer than wide, three hexagonal, two heptagonal, and each one bears a central node. Second primary radials quadrangular, twice as wide as long, and with the third primary radials smaller than the first. Third primary radials about twice as large as the second, one hexagonal, four pentagonal, axillary, and in the ray on each side of the azygous area the distal side supports two secondary radials and the proximal side a single axillary secondary radial, which supports, on each upper side, a single tertiary radial, which gives to each of these rays three arms. In each of the other three rays the third primary radial supports, on each upper sloping side, two secondary radials, which gives to each of these rays two arms. There are, therefore, twelve arms in this species. The arm formula is 3+2+2+2+3.

There is only one regular interradial plate in each area, and it is below the secondary radials and bears a central node. There are six plates in the azygous area. The first one is in line with the first primary radials, and fully as large as either one of them. It bears a central node and is followed by three plates in the second range. A small plate is intercalated on the left of the middle plate, and an elongated plate follows the middle plate of the second range and unites with the plates of the vault. The calyx is longitudinally depressed in the superior part of this area.

The vault is convex, covered with convex, polygonal plates, and bears a subcentral proboscis. It is depressed toward the azygous area.

This species will not be mistaken for any other twelve-armed species. Its affinity seems to be, through *B. approximatus*, with *B. verneuilianus*. The proboscis may be smaller, the interradial and azygous areas somewhat different and there may be other minor differences, but the essential difference is in the arm formula. *B. approximatus* has thirteen ambulacral openings to the vault, *B. verneuilianus* has fourteen ambulacral openings to the vault, and this species has only twelve.

Found in the Burlington Group, at Sagetown, Illinois, and now in the collection of Wm. F. E. Gurley.

BATOCRINUS APPROXIMATUS, n. sp.

Plate IV, Fig. 10, azygous side of an elongated form; Fig. 11, opposite view of the same; Fig. 12, lateral view of a broader form.

Species below medium size, somewhat biturbinate. Calyx obconoidal, from one fourth to three fourths wider than high. No radial ridges. First primary radials and interradials varying from smooth to nodose. An ovarian pore by the side of each ambulacral opening. Ambulacral openings directed horizontally.

Basals form a round cup from two to three times as wide as high and about one-half wider than the diameter of the column. Plates beveled to the column, which is attached in an hemispherical depression. First primary radials nearly as long, or as long, as wide, three hexagonal, two heptagonal, some are nodose and others are smooth. Second and third primary radials together much smaller than the first. Second primary radials quadrangular, about twice as wide as long. Third primary radials a little larger than the second, pentagonal, axillary, and in the ray on each side of the azygous area the distal side supports two secondary radials and the proximal side an axillary secondary radial which supports, on one upper sloping side, two tertiary radials and, upon the other, one, which gives to each of these rays three arms. One of the lateral rays on the right side of some specimens and upon the left side of other specimens is constructed in the same way, and bears three arms. In each of the other two rays the third primary radial supports, on each upper sloping side, two secondary radials, which gives to each of these rays two arms. There are, therefore, thirteen arms in this species. The arm formula is 3+3+2+2+3, or 3+2+2+3+3.

In the elongated specimens there is only one regular interradial in each area, and it is below the secondary radials, but in the broader forms, in some of the areas, there is an additional plate that separates the secondary radials, in one or more of the areas, and unites with the plates of the vault. There are nine plates in the azygous area, in the elongated specimens. The first one is in line with the first primary radials and of about the same size. It is followed by three plates in the second range, three in the third range, and two in the fourth range that unite with the plates of the vault. In the shorter forms there are only eight plates in the azygous area.

The vault is much more convex or conical in the elongated specimens than in the broader forms and it bears a nearly central proboscis.

This species will not be mistaken for any other thirteen-armed species. Its affinities are with *B. affinis* above described and *B. verneuilianus.* The basals form an hexagonal cup in *B. affinis;* horizontally truncated below, a round cup, in this species, beveled to the column, and a round cup, with a band at the bottom in *B. verneuilianus.* There are more azygous plates in this species than there are in *B. affinis*, and as many as there are in *B. verneuilianus.* But the difference, which we regard as most important, is found in the number of ambulacral openings to the vault. We think the difference in form and in the regular and azygous areas would not be of specific importance, without a corresponding difference in the arm formula.

Found in the Burlington Group at Burlington, Iowa. The specimens illustrated are in the collection of A. Albers, but both forms are also in the collection of S. A. Miller, and in that of Wm. F. E. Gurley.

BATOCRINUS VARIABILIS, n. sp.

Plate IV, Fig. 13, azygous side of a regular elongated specimen; Fig. 14, side view of same showing a four-armed ray; Fig. 15, showing a four-armed lateral ray and two plates in the regular interradial areas; Fig. 16, showing a four-armed ray, on the left of the azygous area; Fig. 17, showing a four-armed ray on the right of the azygous area.

Species variable in size, from small to medium; somewhat biturbinate, but varying in this respect. Calyx obconoidal, about one-half wider than high. No radial ridges. First primary radials and interradials varying from plane to nodose. Ambulacral openings directed nearly horizontally and an ovarian pore by the side of nearly every one of them.

Basals form a round cup, about three times as wide as high; it is slightly beveled to the column, which is about two-thirds the diameter of the cup. First primary radials usually as long as wide, three hexagonal, two heptagonal. Second and third primary radials together smaller than the first. Second primary radials quadrangular, about twice as wide as long. Third primary radials a little larger than the second, pentagonal, axillary, and in the specimen represented by figures 13 and 14, the one on each side of the azygous area bears upon the distal side two secondary radials and upon the proximal side a single, axillary secondary radial which bears upon each sloping side two tertiary radials, which gives to each of these rays three arms. The left lateral ray is constructed in the same way, except there is only a single tertiary radial where the other rays have two, and it has, therefore, three arms. In the right lateral ray, as shown in figure 14, there is a single, axillary, secondary radial, on each side of the third primary radial, which bears upon each upper sloping side, a single tertiary radial, which gives to this ray four arms. In the ray opposite the azygous area, the third primary radial bears upon each upper sloping side two secondary radials, which gives to it two arms. There are, therefore, fifteen arms in this species. The arm formula, in the specimen represented by figures 13 and 14, is 3+4+2+3+3. The specimen represented by figure 15 is constructed in the same way, except the left lateral ray has four arms, and the arm formula is 3+3+2+4+3. The specimen represented by figure 16, has the ray on the left of the azygous area bearing four arms, and the arm formula is 3+3+2+3+4. The specimen represented by figure 17 has the ray on the right of the azygous area bearing four arms, and the arm formula is 4+3+2+3+3. It will be noticed that throughout all these variations the ray opposite the azygous area has two arms, and the four-armed ray changes its position to each of the other rays.

There is only a single plate in each of the four regular interradial areas in the specimens represented by figures 13, 14 and 16. And there are two plates in each of the regular interradial areas, in the specimens represented by figures 15 and 17. In the azygous area, in the specimen represented by figure 13, there are six plates. The first one is in line with the first primary radials and as large as either one of them. It is followed by three plates in the second range, subequal in size, and above these, there are two plates, one of which unites with the two plates belonging to the vault. The specimen represented by figure 17 has the same number of plates in the azygous area, but there is a little difference in the arrangement of the plates at the upper part of the area.

The specimen represented by figure 16 has seventeen plates in the azygous area. There are two small plates instead of one in the third range.

The vault is more convex in some specimens than in others. the proboscis is larger in some specimens than in others. The number and arrangement of the plates covering the vault is quite different in different specimens, as shown in figure 14 and 17.

Notwithstanding all these variations, we place all these forms in the same species, because, in each one, the number of ambulacral openings to the vault is the same. Other differences might be pointed out from other specimens, as, for example, some specimens have a single plate, in some of the regular interradial areas, and two in others, but those pointed out are the controlling variations.

There has never been but one fifteen-armed species heretofore described, from the Burlington Group, and it has no resemblance to this one. The affinities of this species are with *B. verneuilianus* and the two species are to be distinguished by the number of ambulacral openings to the vault. We have examined several hundred specimens of *B. verneuilianus*, and, while they differ in size, form and regular and azygous areas as much as the species here under consideration, they always have fourteen ambulacral openings to the vault. When Shunard described *B. verneuilianus*, he called it an *Actinocrinus*, because the genus *Batocrinus* was then unknown, and following the ordinary structure of *Actinocrinus*, in his definition, he said there were only two plates, in the second range, in the azygous area, but there are three. He described the fourteen-armed species and gave the localities where it has been found in abundance; but, he said, "the number of arm-openings, in the specimens under examination, varies from fourteen to fifteen." He probably had some specimens of this species, which he did not distinguish from *B. verneuilianus*. But twenty specimens of that species are found in Missouri, Iowa and Illinois to where one is found belonging to this species, and there can be no doubt about which one he regarded as the type of his species.

Found in the Burlington Group, in Iowa, Missouri and Illinois, and in all good collections from that Group. Three of the specimens illustrated are in the collection of S. A. Miller and one in the collection of A. Albers.

BATOCRINUS COGNATUS, n. sp.

Plate IV, Fig. 18, azygous side, a three-armed ray on the right and a four-armed ray on the left; Fig. 19, four-armed ray on the right lateral side of same specimen; Fig. 20, four-armed ray on the left of the azygous area in another specimen; Fig. 21, a four-armed ray and three plates in an interradial area.

Species variable in size from small to medium; somewhat biturbinate, but varying in this respect. Calyx obconoidal, about one-half wider than high. No radial ridges, but arms more or less clustered at the margin. Ambulacral openings directed nearly horizontally and an ovarian pore by the side of nearly every one of them.

Basals form a round cup about four times as wide as high; it is slightly beveled to the column, which is about two-thirds the diameter of the cup. First primary radials usually wider than long, three hexagonal, two heptagonal. Second and third primary radials together not larger than the first. Second primary radials quadrangular, two or two and a half times as wide as long. Third primary radials about twice as large as the second, pentagonal in such forms as are represented in Figures 18 and 19, but hexagonal, in part of the rays, in such forms as are represented by figures 20 and 21, axillary, and in the ray opposite the azygous area, supports, on each upper sloping side, two secondary radials, which gives to this ray two arms. In the specimen represented by Figures 18 and 19, in the ray on the left of the azygous area, the third primary radial supports, on each upper side, a single, axillary, secondary radial, which supports, on each upper sloping side, two tertiary radials, except in one of the middle branches there is only one tertiary radial, which gives to this ray four arms. The ray, on the right lateral side, is constructed in the same way, except each of the proximal branches bears only a a single tertiary radial, and it has four arms. The ray on the right of the azygous side bears, on the distal side of the third primary radial, two secondary radials, and, on the proximal side, two secondary radials, the last one being axillary, and supporting, on each upper side, two tertiary radials, which gives to this ray three arms. The left lateral ray is constructed in the same way, except there is one less secondary radial and it bears on one side two tertiary radials and on the other, one; it has three arms. There are, therefore, sixteen arms in this species. The arm formula, in such specimens as are represented by Figures 18, 19 and 21, is 3+4+2+3+4. But in the specimen represented by Figure 20, the arm formula is 3+3+2+4+4.

In the specimen represented by Figures 18 and 19, there are two plates in one of the regular interradial areas and one in each of the others. In the specimen represented by Figure 20, there is one plate in one of the areas and two in each of the others. In the specimen represented by Figure 21, there are three plates in each of two areas and two plates in each of the others. In the azygous area there are eight plates. The first one is in line with the first primary radials and of about the same size. It is followed, in the second range, by three plates, and these by three plates, in the third range, above the middle one of which rests a single plate that unites with the plates of the vault. In one specimen we notice an additional small plate above the third range. The area is much more depressed between the rays in some specimens than in others.

The vault is more convex in some specimens than in others. In the spreading forms shown by Figure 21, the vault is only moderately convex, while in the biturbinate forms shown in Figure 18, the vault is conical; the proboscis is proportionally much smaller, in the spreading forms, than in the biturbinate.

It will be noticed that the variations in shape, and in the regular interradial areas, are as great in this species as they are in *B. variabilis*, and it is probable that other specimens may show another variation, in the arrangement of the arms; that is, a four-armed ray, on each side of the azygous area, and a three-armed ray on each lateral side. As a matter of course the affinities of this species are with *B. variabilis*. It will be noticed that the ray opposite the azygous area has two arms in *B. affinis*, *B. approximatus*, *B. verneuilianus*, *B. variabilis* and *B. cognatus*. The different species have respectively twelve, thirteen, fourteen, fifteen and sixteen ambulacral openings to the vault, but, in all the changes, one of the rays remains the same. Here is the greatest and best defined evolution, through five species, that has ever been found among the palaeozoic crinoids. In *B. verneuilianus*, the two-armed ray sometimes changes place with the right lateral ray and sometimes with the left lateral ray, otherwise it is always opposite the azygous area. Suppose we were to throw all these species into one, as an illiterate and inexperienced pretender might do, what would be the result? It would simply wipe out all specific characters belonging to *Batocrinus*; for, if the arm formula, within the calyx, is not of specific importance, there is no specific character found in the genus, and if all these five species can be dumped into one species, all the rest may be made to follow. This is not indicating that these five species are not closely related, for we think they are. They have a wide geographical range, and are represented by numerous specimens, at many localities. What we think is, that here is an evidence of evolution of species, accompanied with varietal changes in each species, which tends to prove that one species arose from another, or might have arisen from another. We have no idea which species came first into existence or from whence it came. It may have been that from the twelve armed species arose all the others, or it may have been that the commencement was from the fourteen-armed species, and, that, by evolution, rays were gained in one direction and lost in another. If the more numerously rayed species were to be regarded as the more highly developed, it would be taking for granted, as a fact, that which the fossils do not prove and that which we have no right to assume, no matter what emphasis we may place on the number as a test of specific importance. We have not used the word *Eretmocrinus*, for the species under consideration are true *Batocrinus*.

The specimens illustrated are from the Burlington Group, from Burlington, Iowa, and from the collections of A. Albers and S. A. Miller, but others occur in all large collections, for the species is not rare.

BATOCRINUS CONSANGUINEUS, n. sp.

Plate IV, Fig. 22, azygous view; Fig. 23, opposite side.

Species about medium size, somewhat biturbinate. Calyx obconoidal, most rapidly spreading in the superior part so as to appear broadly constricted in the middle part; truncated below. No radial ridges. Ambulacral openings directed nearly horizontally, but not visible in a basal view, though they may be seen, in part, from the summit view. Plates plane, in our specimen, though the larger ones may be nodose in other specimens. A few ovarian pores only are distinguished in our specimen, but, probably there is one to each ambulacral opening. The diameter of the calyx is about one-half more than the height.

Basals form a rounded cup about one-third as high as wide, and very gradually spreading from the column. The columnar pit is hemispherical and it is rather sharply rounded at the margin to the outer side of the cup. First primary radials wider than long, three hexagonal, two heptagonal. Second and third radials together smaller than the first. First primary radials, quadrangular, between two and three times as wide as long. Third primary radials very little larger than the second, one hexagonal, the others heptagonal, axillary, and supporting on each superior sloping side two secondary radials, the last ones being axillary and supporting on each upper side a single tertiary radial, which gives to each ray four arms and four ambulacral openings to the vault. There are, therefore, twenty arms to this species. The arm formula is 4+4+4+4+4.

In one of the regular interradial areas there are three plates, one followed by two, in the second range. In another area there are four plates, one followed by two in the second range, and one in the third range. In another area there are five plates, one followed by two in the second range, and two in the third range. In the other area there are six plates. These areas are all cut off from the plates of the vault by the union of the tertiary radials, excepting the one having six plates, and one of these extends to the vault. In the azygous area, there are nine plates. The first one is in line with the first primary radials and of about the same size. It is followed by three plates in the second range, three in the third range, one on the right of the top of the middle plate in the third range, and one following the middle plate and uniting with two plates belonging to the vault. There is one plate in one of the intersecondary areas.

Vault moderately convex, covered with numerous polygonal plates and bearing a small subcentral proboscis.

This species does not seem, by its general form and structure, to be nearly related to any other twenty-armed species, and it cannot be mistaken for any of them. In its general form and surface characters, it seems to be related to *B. affinis*, *B. approximatus*, *B. verneuilianus*, *B. variabilis* and *B. Cognatus*. Indeed, were it not for the number of arms, it might be mistaken for either one of them. The variable character of the regular interradial areas reminds one of *B. variabilis*, *B. verneuilanus* and *B. cognatus*, and if we had other specimens, we might expect to find great differences, in this respect, in different specimens, and, probably, also, in the azygous areas. The one thing, only, that would stand to distinguish the species would be the number of arms. That is all the distinguishing specific character we discover now, though we have only a single specimen of this species, while we have hundreds of the others. We have not discovered any eighteen-armed species in this line of evolution of species, but we expect it will be found. We have a nineteen armed specimen but it is abnormal and may have resulted from some unknown injury to a fifteen, sixteen, or twenty-armed species or an ununknown eighteen or nineteen-armed species. We figure it below.

Found in the Burlington Group, at Burlington, Iowa, and now in the collection of A. Albers.

AN ABNORMAL SPECIMEN.

Plate IV, Fig. 24, right side view; Fig. 25, adjoining side view.

The general form of the specimen here illustrated is that of the last five above described species and their kindred, *B. verneuilianus*. It belongs to one of those six species or to an unknown eighteen or nineteen-armed species. The basal plates appear to be normal and so do four of the first primary radials, and the first azygous plate, followed by three plates, in the second range. Otherwise the plates of the calyx are not in a normal position, though the specimen appears to have been fully developed, has nineteen ambulacral openings to the vault and supports a large proboscis.

The first primary radial opposite the azygons area is a small axillary plate, and may be seen on the left of figure 25. On one of its upper sloping sides there are two plates in an interradial position, and on the other sloping side there are three primary radial plates, the last one being axillary, and supporting on each upper side, a secondary radial, which bears an ambulacral opening, and if this were all, the ray would bear two arms, and the specimen would not belong to a twenty-armed species. But the second plate, in the series of three, is axillary and if the ray were straightened it would be the third primary radial, and the ray would have four arms. This may be seen on the left of figure 25 and on the right of figure 24, as the two figures may be put together, with a slight overlapping. However, when you look at figure 24 you can see, on the right, the series of three radial plates, apparently occupying an interradial position, and a radial series running off to the right that looks as if it might be the support of the two ambulacral openings that we have just given to the ray opposite the azygous area. This leaves in doubt the question whether the ray opposite the azygous area, in the normal condition, had two ambulacral openings or four. If it had four the species possessed, probably, twenty arms. Looking at figure 24, you will see three ambulacral openings above an interradial area. If the ray were straightened and the two ambulacral openings, on the right, given to the ray opposite the azygous area, the ray would take these three openings above the interradial area, and the ray would then have five arms. Probably this is where the specimen is dwarfed and the two openings, on the left, should be crowded over to the next ray, and the single opening should be represented by two openings, and then there would be twenty arms, in the species. If, however, this belonged to *B. consanguineus*, then the species was as variable in form, as we have found *B. variabilis* and *B. cognatus* to be. As a matter of course, where ambulacral plates are over interambulacral areas, the ambulacral canals curved so as to unite the circulation through the regular ambulacral channels. From the appearances, we are inclined to believe that this specimen belongs to a twenty armed species, and certainly, in a normal condition, possessed as many as nineteen arms. The injury or abnormal development did not, as we think, increase the number of ambulacral openings to the vault, the tendency, if in any direction, would be to decrease them.

Found in the Burlington Group, at Burlington, Iowa, and now in the collection of S. A. Miller.

ANOTHER ABNORMAL SPECIMEN.

Plate IV, Fig. 26, azygous side; Fig. 27, opposite view.

The general form of this specimen is that of *B. cognatus* and it has sixteen arms. The azygous side is normal and the injury is in the ray opposite the azygous area. The azygous area is not exactly like a typical area in *B. cognatus*, because it is wider, in the superior part, and the plates are somewhat differently arranged, but it is near enough to that species to classify it there, unless for another reason it belongs elsewhere. The ray opposite the azygous area is bent out of shape, the plates are displaced, and it bears three arms. The arm formula, as represented in the specimen, is 3+3+3+4+3. Suppose the ray were straightened and supported only by two arm openings directly in line with it, and that the ambulacral openings, which are above the interradial area, on the left, belonged to the ray on the left, the arm formula would be 3+4+2+4+3, which would represent, what we suppose would be, one of the normal varietal forms of *B. cognatus*. And it may be, after all, that the interior will show that to be the arrangement of the ambulacral canals. If so, it makes *B. cognatus* as variable as *B. variabilis*. We think *B. cognatus* will never be found with a normal ray having three arms opposite the azygous area. But we think the specimen under consideration is a *B. cognatus*, and that an injury produced the crooked radial series and displaced the ambulacral openings to the vault. If this view is correct, then the abnormal specimen represented by figures 24 and 25, for additional reasons, belongs to a ninteen or twenty-armed species.

Found in the Burlington Group, at Burlington, Iowa, and now in the collection of A. Albers.

BATOCRINUS ARGUTUS, Miller & Gurley.

[*Batocrinus argutus*, Miller & Gurley, 1896, Bull. No. 8, Ill. St. Mus. Nat. Hist., p. 9, pl. 1, fig. 8 and 9.]

The type of this species has twenty-one arms, two plates in each interradial area, the second one small, and six plates in the azygous area, 1+3+2. The five-armed ray is on the left of the azygous area as we see it looking at the illustration.

Mr. F. A. Sampson has a specimen from the same locality having a similar form and twenty-one arms. But the five-armed ray is on the right of the azygous area, there is only one plate in each regular interradial area, and five plates in the azygous area, 1+3+1. The question presented is whether or not these differences are of specific importance. A single additional small plate, in any one interradial area could hardly be claimed to be of specific importance; and, for the same reason, we think the additional small plate, in each area, is not of specific importance. We allow for greater variation, in the interradial area, within the limits of a species, than we do in the arm formula, in the calyx, and yet, there is an absence of definiteness, in a description, that reads "one or two regular interradials and five or six azygous plates." However, in this case, it is a small plate that is absent, in each area, and which does not noticeably change the form of the body.

Having disposed of these differences, the question still remains, whether or not the arrangement of the five-armed ray on the right or left side of the azygous area is of specific importance. We think it is not, and this leads us to some general remarks concerning the structure of crinoids. We think the azygous side of the calyx is the anterior side and the opposite side the posterior side. The early palæontologists took the contrary view, and much of the literature is written that way, and Billings, doubting the correctness of the old view, and probably believing as we do, proposed the use of the word azygous, as applied to one side, and we have followed his method of nomenclature, in order that our definitions might the more readily be compared with the work of others. Believing that the azygous side is the anterior side of the crinoid, we can see no reason why, in a twenty-one-armed species, it should be deemed material whether the five armed ray is on the right or left side of the front interradial space, and the examination of large quantities of material belonging to many species seems to us to indicate that it is not of specific importance. But it does seem material, whether a five-armed ray is on the anterior side, in one specimen, and on the posterior side in another; for here the variation is in essentially different parts of the body, and our observations, in all cases, even in *Batocrinus variabilis*, confirms this view.

We are aware that some pseudo-biologists call the vault the ventral side of a crinoid and the calyx the dorsal side; but the

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Mr. F. A. Sampson has a specimen from the same locality having a similar form and twenty-one arms. But the five-armed ray find hundreds of specimens, differing in size, but possessing absolutely the same characters, but do not find any near relative, and, in such case, we claim to have found a distinct species. The intermediate forms, if such existed, we do not find, and hence, are unable to ascertain from what direction the species came or where it drifted. The development, in a particular direction, may have been arrested by the extinction of the species, and, in such case, the last form would be stamped with unalterable characters. It is common, in the genus *Batocrinus*, to find specimens differing, only, in the number of plates, in one or more of the interradial areas. That is, the specimens will have the same general form and appearance, and the same arm formula, and the same structure, in the lower part of the regular interradial and azygous areas, but, in the superior part of one or more of the areas, there will be one or two more plates in one specimen than in another. In *B. argutus*, there would be three species, if the variations in the interradials above mentioned were of specific importance, and if we had more specimens we might have more of the same kind of variations. *B. glaber* would furnish eight or ten species, among the specimens, in our collections, if such variations constituted specific differences. And so we might almost indefinitely increase the species of *Batocrinus*, if such variations are of specific value. It is quite true, too, that numerous specimens have been collected belonging to some of the species of *Batocrinus*, that have shown no differences in the interradial plates. But that does not prove that other specimens will not show any differences. It is no evidence at all. On the contrary, it is consistent with what we know of animal life to suppose that other specimens will show variations, notwithstanding the apparent fixity in form and structure of any number of specimens that we might happen to collect in any particular species. The number that any one may happen to be fortunate enough to see, in any of these fossil species, is like a drop in the ocean when compared with the millions of specimens that must have existed.

vault was never ventral to the body of the animal, nor was the calyx dorsal to the body of the animal. The words ventral and dorsal cannot be applied to a crinoid, in this way, with any more reason than the roof of a house can be called the ventral side and the cellar the dorsal side. The crinoid stood upright, and all the organs were in that position, except the ovarian pores and ambulacral canals, from the base of the arm to the ring surrounding the top of what Meek called the "convoluted organ." One side was evidently anterior and the other posterior, and we have no doubt that the azygous side is the anterior side and the opposite one posterior. Looking at the crinoid in this view, the left side is the right side of an illustration. But in all cases, when we have used the words right side or left side, we have referred to the illustration and not to the disputed question as to which was the right side or the left side of the animal itself. It is no easy task to reform the crinoid literature and reduce it to a uniform, plain system, governed by a simple statement of the facts as they are known to exist, and we have not undertaken it.

Mr. A. Albers has a specimen of *B. argulus*, from Burlington, Iowa, that has the arms arranged just as they are in the type, and it has the same form and number of regular interradials, but it has seven axygous plates instead of six. The additional azygous plate is a small one in the third range on the left of the azygous area. The fact that this twenty one armed species occurs at Sedalia and at Burlington, is another evidence of the fixity of the species, and of the value of the radial series, within the calyx, in determining the limit of a species.

In describing *B. argulus*, we were made to say, that it is the first species bearing twenty-one arms, described from the Burlington Group; but we should have said, it is the second species, for *B. rotundus* was described many years ago and possesses twenty-one arms.

The study of animal life has led the most extensive observers and best thinkers to the conclusion that nature is continuous, and the more complete the knowledge of any particular family or genus, the less differentiated are the species, in the mind of the observer, because of the existence of intermediate forms. There are hard lines, however, that separate many species, in the fossil world, and these are found, evidently, among the crinoids. We find hundreds of specimens, differing in size, but possessing absolutely the same characters, but do not find any near relative, and, in such case, we claim to have found a distinct species. The intermediate forms, if such existed, we do not find, and hence, are unable to ascertain from what direction the species came or where it drifted. The development, in a particular direction, may have been arrested by the extinction of the species, and, in such case, the last form would be stamped with unalterable characters. It is common, in the genus *Batocrinus*, to find specimens differing, only, in the number of plates, in one or more of the interradial areas. That is, the specimens will have the same general form and appearance, and the same arm formula, and the same structure, in the lower part of the regular interradial and azygous areas, but, in the superior part of one or more of the areas, there will be one or two more plates in one specimen than in another. In *B. argutus*, there would be three species, if the variations in the interradials above mentioned were of specific importance, and if we had more specimens we might have more of the same kind of variations. *B. glaber* would furnish eight or ten species, among the specimens, in our collections, if such variations constituted specific differences. And so we might almost indefinitely increase the species of *Batocrinus*, if such variations are of specific value. It is quite true, too, that numerous specimens have been collected belonging to some of the species of *Batocrinus*, that have shown no differences in the interradial plates. But that does not prove that other specimens will not show any differences. It is no evidence at all. On the contrary, it is consistent with what we know of animal life to suppose that other specimens will show variations, notwithstanding the apparent fixity in form and structure of any number of specimens that we might happen to collect in any particular species. The number that any one may happen to be fortunate enough to see, in any of these fossil species, is like a drop in the ocean when compared with the millions of specimens that must have existed.

BATOCRINUS REPERTUS, n. sp.

Plate IV, Fig. 28, azygous side; Fig. 29, opposite view; Fig. 30. summit.

Species below medium size. Calyx bowl-shaped, the projections of the radial series at the top give it a somewhat pentagonal outline, when seen from above; more than one-half wider than high. Plates convex. Radial ridges undefined. Surface finely granular. Column small and pierced by a small, cinquefoil canal.

Basals form a small hexagonal disc, with re-entering angles. The disc expands slightly upward and has a diameter about one-half greater than the diameter of the column, which is inserted in a rounded, radiately lined depression below. The lower and outward sides of the basals are rounded. First primary radials the largest plates in the body, a little wider than long, three hexagonal, two heptagonal. Second and third primary radials together smaller than the first. Second primary radials, quadrangular, twice as wide as long. Third primary radials a little larger than the second, one heptagonal, two hexagonal and two heptagonal, axillary, and, in the ray opposite the azygous area, which bears the heptagonal plate, support, on each upper sloping side, two secondary radials, which gives to this ray two arms. In the ray, on each side of the azygous area, the third primary radials, which are pentagonal, support, on each upper sloping side, two secondary radials, the last one, which adjoins the area, is axillary, and supports, on each upper side, a single, tertiary radial, which gives to each of these rays three arms. One of the lateral rays is constructed in the same way and bears three arms. In the left lateral ray, the second secondary radials are both axillary, and support, on each upper side, a tertiary radial, which gives to this ray four arms. There are, therefore, fifteen arms in this species. The arm formula is 3+3+2+4+3.

There are three plates in each regular interradial area, one followed by two smaller ones, in the second range, which do not connect with the vault. There are nine plates in the azygous area. The first one is in line with the first primary radials and about the same size. It is followed by three plates, in the second range, three plates, in the third range, and two plates in the fourth range, that connect with the plates of the vault.

Vault only moderately convex and covered with small, convex, polygonal plates, and bears a subcentral proboscis.

This species has little or no resemblance to *B. modulus* or *B. variabilis*, the other two species, bearing fifteen arms, described from the Burlington Group. In form, it more resembles *B. adamsensis*, a ten-armed species, or *B. imparilis*, a twelve armed species, or *B. longirostris*, an eighteen-armed species. A very beautiful series of bowl-shaped species might be arranged, bearing from ten to twenty arms.

Found in the Burlington Group, at Sedalia, Missouri, and now in the collection of F. A. Sampson.

BATOCRINUS SEDALIENSIS, n. sp.

Plate IV, Fig. 31, azygous sde; Fig. 32, opposite view.

Species rather below medium size, biturbinate, vault having a capacity equal to or greater than the calyx. Calyx obconoidal, about twice as wide as high. Plates pyramidal.

Basals small, thin, and projecting slightly beyond the end of the column. First primary radials about one-half wider than long and sharply pyramidal, three hexagonal, two heptagonal. Second and third primary radials together very little larger than the first. Second primary radials quadrangular, about twice as wide as long. Third primary radials larger than the second, three hexagonal, two pentagonal, axillary, and supporting, on each upper sloping side, a single secondary radial, which is axillary, and supports, on each upper sloping side, a single tertiary radial, which gives to each ray four arms and four ambulacral openings to the vault. There are, therefore, twenty arms in this species. The arm formula is 4+4+4+4+4.

The azygous and regular interradial areas are cut off from the plates of the vault by the union of the tertiary radials above them. There are three plates in each regular interradial area, one followed by two smaller ones, in the second range. There are six plates in the azygous area. The first one is in line with the first primary radials and larger than either one of them. It is followed by three plates in the second range, one, in the third range and one in the fourth range.

The vault is broadly and highly convex and bears a small subcentral proboscis. It is covered with polygonal plates that are produced in short, sharp spines.

This species is probably most nearly related to *B. proboscidialis*, which was described by Hall as *Actinocrinus pro boscidialis*, and has generally been referred to *Actinocrinus*, by later authors, though it is a true *Batocrinus*. If, however, the character of the vault and proboscis is of specific importance, they may be readily distinguished. In *B. proboscidialis* the vault is terete conical, and is gradually produced into a large and long proboscis. In this species the vault is broadly convex and bears a small subcentral proboscis. The species are farther distinguished by the following characters. In *B. proboscidialis*, the surface of the plates of the calyx is marked by short angular ridges, which terminate in a bi-nodose, transverse ridge, on the first radials, and in a strong angular node above; in this species, there are no angular ridges, or bi-nodose, transverse ridges, but the plates are all pyramidal and terminate in angular points. In *B. proboscidialis* there are four plates in each regular interradial area disposed in three ranges; in this species there are three plates, disposed in two ranges. The azygous areas are also different. But notwithstanding all these differences, both species have the same arm formula and the same number of secondary and tertiary plates, in the calyx, and, therefore, must be nearly related.

Found by R A. Blair, in the Burlington Group, at Sedalia, and now in the collection of S. A. Miller.

BATOCRINUS SUBÆQUATUS, n. sp.

Plate IV, Fig. 33, azygous side; Fig. 34, opposite view; Fig 35, summit.

Species small, below medium size, biturbinate, calyx and vault subequal in capacity. Calyx bowl-shaped, slightly flattened, in the superior part of the interradial areas, about one-third wider than high. Radial ridges undefined. Plates convex. Surface granular.

Basals form an hexagonal, slightly expanding, disc, truncated the entire width below, by the column, which is supported in a radiately lined, hemispherical depression. First primary radials as large as the second and third together, wider than long, three hexagonal, two heptagonal. Second primary radials quadrangular, twice as wide as long. Third primary radials a little larger than the second, pentagonal, axillary, and in each ray adjoining the azygous area, bear upon the distal side, two secondary radials, and upon the proximal side, an axillary radial, which bears upon each sloping side a single tertiary radial, which gives to each of these rays three arms. One of the lateral rays is constructed in the same way and bears three arms. In the other lateral ray and in the ray opposite the azygous area, the third primary radials support, upon each upper sloping side, two secondary radials, which gives to each of these rays two arms. There are, therefore, thirteen arms in this species. The arm formula is 3+2+2+3+3.

The azygous and regular interradial areas are all cut off from the vault by the union of the radial plates above them. There is one regular interradial in each area. There are five plates in the azygous area. The first plate is in line with the first primary radials and longer than either of them. It is followed by three plates in the second range, and a smaller intercalated plate to the right of the upper part of the middle plate.

The vault is obconoidal, covered with polygonal plates and bears a central proboscis.

This species has little resemblance to either of the other three thirteen-armed species that have been described from the Burlington Group, and need not be compared with any of them. It is quite a peculiar species, and at present we do not know where its nearest relative may be found.

Found by F. A. Sampson, in the Burlington Group, at Sedalia, Missouri, and now in his collection.

REMARKS ON THE FAMILY ACTINOCRINIDÆ.

This family prevails above all other crinoids, in the Subcarboniferous rocks of North America. It first appeared, as now understood, and of course, we can only speak within the limits of the present state of learning, in the Niagara Group of the Upper Silurian, and ended, within the Subcarboniferous. The Upper Silurian genera are *Cylicocrinus* and *Saccocrinus*, neither of which are known to occur in the Devonian or Subcarboniferous, though one species, described by Meek and Worthen, as *Actinocrinus amplus* from the Burlington Group, has been referred to Saccocrinus. The species is nearer *Actinocrinus* than *Saccocrinus* and is best retained, in the genus, to which it was first referred. It cannot be considered as a connecting link, until a way is found, to pass through the Devonian System and Chouteau Group. Two species of *Cylicocrinus* have been described and the specimens are small. Fifteen species of *Saccocrinus* have been described, varying greatly in size, but *S. urniformis* and *S. marcouanus* have the largest bodies belonging to any species, in the *Actinocrinidæ*. There are ten ambulacral openings to the valt in *Cylicocrinus*, but whether or not the arms bifurcate after becoming free is unknown. In *Saccocrinus* there are either ten or twenty ambulacral openings to the vault, and the arms, in *Saccocrinus speciosus* are known to bifurcate twice after becoming free, giving to that species forty arms, and, in other cases, where there are twenty ambulacral openings, the arms are known to bifurcate once so as to give the species, at least, forty arms.

The Devonian genera are *Gennæocrinus*, *Megistocrinus* and the species described by Hall from the Hamilton Group as *Actinocrinus præcursor*, which may be a *Batocrinus*. There are seven speceies of *Gennaeocrinus*, and, in those species, in which the arms have been described, there are sixteen, twenty, thirty and forty arms. None of the species have large bodies. There have been twenty-five species of *Megistocrinus* described. They are generally large, ranking next to *Saccocrinus*, though quite variable, in size; but there is great uniformity, in the general shape of the different species. This genus occurs in different Groups of the Devonian System and in the Kinderhook and Burlington Groups of the Subcarboniferous. It is the only genus, in this family, that is known to pass from one geological system to another. The arms of the various species are, generally, unknown, some of them, probably, bifurcate and others do not. The ambulacral openings to the vault, in some of the species, cannot be determined from the imperfect descriptions that have been written. and there is doubt about others. Among the Devonian species, the number of ambulacral openings to the vault, that are definitely known, are ten, fourteen, sixteen, seventeen, twenty, twenty-seven and thirty, and in the Kinderhook and Burlington Groups ten and twenty. The prevailing Devonian species have sixteen ambulacral openings, a number thus far unknown, in the Subcarboniferous.

In the Subcarboniferous system we find *Actinocrinus*, *Agaricocrinus*, *Alloprosallocrinus*, *Amphoracrinus*, *Batocrinus*, *Blairocrinus*, *Dorycrinus*, (*Megistocrinus* above mentioned) *Physetocrinus*, *Sampsonocrinus*, *Shumardocrinus*, *Steganocrinus*, and *Strotocrinus*. In this disposition of the genera we regard *Eretmocrinus* as a synonym for *Batocrinus* and *Teleiocrinus* as a synonym for *Strotocrinus*.

Blairocrinus, *Sampsonocrinus* and *Shumardocrinus* are confined to the Chouteau limestone. There are four species of *Blairocrinus*, each of which bears twenty arms, one species of *Sampsonocrinus* that has nineteen ambulacral openings to the vault, and one species of *Shumardocrinus* that has five ambulacral openings to the vault, and the free arms are not known in either species. There are five species of *Actinocrinus* described from the Chouteau limestone and Kinderhook Group, having twenty, twenty-two, and thirty ambulacral openings to the vault. Four species of *Agaricocrinus*, having nine and ten ambulacral openings. Four species of *Amphoracrinus* having six and ten ambulacral openings and one with twenty arms. Three species of *Batocrinus*, having twenty ambulacral openings. And three species of *Dorycrinus* having respectively twelve, fourteen and eighteen arms.

Physetocrinus, *Steganocrinus* and *Strotocrinus* are confined to the Burlington Group. There are nine species of *Physetocrinus*, having twenty, thirty-four, forty and fifty arms. There are four species of *Steganocrinus*, having five large, ambulacral openings to the vault and numerous armlets of a peculiar character. And there are twenty species of *Strotocrinus*, having twenty, twenty-six, thirty, forty, fifty, sixty, seventy, eighty and one hundred arms. There are fifty-three species of *Actinocrinus*, described from the Burlington Group, having ten, twenty, twenty-one, twenty-two, twenty-four, twenty-nine, thirty, thirty-six and forty arms; the greater number have twenty and thirty arms. Eighteen species of *Agaricocrinus*, having ten and twelve arms. Six species of *Amphoracrinus*, having ten, twenty and twenty-two arms. One hundred and eleven species of *Batocrinus*, having eight, ten, twelve, thirteen, fourteen, fifteen, sixteen, seventeen, eighteen, nineteen, twenty, twenty-one, twenty-two, twenty-three, twenty-four, twenty-six and twenty-seven arms, the prevailing species having eighteen, twenty and twenty-two ambulacral openings to the vault. And twenty-three species of *Dorycrinus*, having ten, eleven, twelve, thirteen, fourteen, fifteen, sixteen, seventeen, nineteen and twenty arms, the prevailing species having twelve and sixteen arms.

There is no genus confined to the Keokuk Group, and all that are found within it passed up from the Burlington Group below, except *Alloprosallocrinus*. There are twelve species of *Actinocrinus*, having twenty-five, twenty-nine, thirty, thirty-eight and forty arms or more. A peculiarity, in some of the species, as in *Actinocrinus gibsoni*, is the bifurcation of the arms after they become free, as they do, in some species of *Saccocrinus*. The prevailing species have thirty ambulacral openings to the vault. There are seventy-two species of *Batocrinus*, having twelve, fourteen, fifteen, sixteen, seventeen, eighteen, twenty, twenty-one, twenty-two, twenty-four, twenty-five, twenty-six, twenty-eight, twenty-nine, thirty, thirty-two, thirty-six and forty arms. The prevailing species have sixteen, seventeen, eighteen and twenty arms. There are eighteen species of *Agaricocrinus*, having ten, twelve, thirteen, fourteen, sixteen and eighteen arms. The prevailing species have ten and twelve arms. There is only a single species of *Alloprosallocrinus*, and it has eleven arms. There is only a single species of *Amphoracrinus*. It was originally referred to the Waverly Group and described under the name of *Actinocrinus viminalis*. It has only ten ambulacral openings to the vault, but the arms bifurcate so that there are forty arms in the superior part. The association of crinoids at Richfield, in Summit county, Ohio, very clearly indicates that the rocks are above the Waverly Group and belong to the Keokuk. There are seven species of *Dorycrinus*, having sixteen, seventeen and twenty arms. The prevailing species have twenty arms.

Authors have not clearly distinguished between the Warsaw and St. Louis Groups, though most of the species are referred to the Warsaw Group, and there are so few species we will consider the two Groups together. First, it will be noticed, that no *Actinocrinus* are found above the Keokuk Group. Sixteen species of *Batocrinus* have been described, having seventeen, eighteen, twenty and forty arms. The principal species have eighteen and twenty arms. One *Dorycrinus* has been described having ten arms and three species of *Alloprosallocrinus*. And here the family of the *Actinocrinidæ* became extinct, unless *Batocrinus copiosus* is a representative of the Kaskaskia Group. It was credited to the Kaskaskia Group, when it was described, but we are now of the opinion that it came from rocks of the age of the Warsaw or St. Louis Groups, and that, so far as our knowledge now extends, the family of the *Actinocrinidæ*, during the age of the St. Louis Group, ceased to exist.

We have mentioned eighteen genera belonging to the *Actinocrinidæ*, which are more than belong to any other family of crinoids; and we have enumerated four hundred and fifty-two species belonging to it, which are more than belong to any other family. We have called attention to the geological distribution of the genera and species and also to some of the distinguishing characteristics. What conclusions, if any, are to be drawn from the facts thus set forth?

It appears that *Saccocrinus*, the first genus to appear on the stage, grew to the largest size, developed fifteen species, bearing from ten to twenty ambulacral openings to the vault, and that the arms bifurcate, in *Saccocrinus speciosus*, twice after becoming free. (See Pal. N. Y., vol. 2, Pl. XLVI, fig. 1). The same kind of arms and the same method of bifurcation may be seen in *Amphoracrinus viminalis* from the Keokuk Group. (See North American Geology and Palæontology, p. 222; and Ohio Pal., vol. 2, Pl. II, figs. 12 and 13). And the same kind of arms and the same method of bifurcation may be seen in *Actinocrinus gibsoni*, from the Keokuk Group. (See Bull. No. 3, Ill. St. Mus. Nat. Hist., Pl. II, fig. 1). And the same may be seen in other genera and species, in large collections, which have not been illustrated. It follows, therefore, that bifurcating arms composed of a double series of interlocking plates is not a feature of generic importance. This might be proved again by the single and double arms, in the same specimen, in different species of *Batocrinus*, illustrated on Pl. I, in Bull. No. 7, Ill. St. Mus. Nat. Hist. The number of ambulacral openings to the vault is not of generic importance, not only as shown by *Saccocrinus*, but by *Megistocrinus*, *Batocrinus* and other genera that include numerous species.

The largest forms and very small ones appeared abruptly in *Saccocrinus* and *Cylicocrinus*, in the Niagara Group, as perfect, in all their parts, so far as we know or have reason to believe, as any that existed in later periods; and they became extinct as abruptly as they appeared, in the same geological age. There are no intermediate forms—from these genera to *Gennæocrinus* and *Me-*

gistocrinus—that appeared as abrubtly in the Upper Helderberg and Hamilton Groups. There is no process of development or evolution of which we have or can have any conception that will link any of these genera together by lines of direct descent. *Megistocrinus* survived until the age of the Burlington Group, and then disappeared as abruptly as it came into existence; and during all that time specific variations were taking place, but there are no indications of another genus branching from it or arising out of it. *Blairocrinus, Sampsonocrinus* and *Shumardocrinus* appeared without progenitors and disappeared without descendants in a single geological age. Suppose that from *Gennæocrinus* arose *Actinocrinus* and *Amphoracrinus*, and from the form called *Actinocrinus præcursor* arose *Batocrinus*, we still have the abrupt appearance of *Agaricocrinus* and *Dorycrinus* in the Chouteau Group, without progenitors, and they became extinct without having developed other genera. We might suppose that from *Actinocrinus* and *Amphoracrinus* arose *Physetocrinus, Steganocrinus* and *Strotocrinus*, and from *Batocrinus* arose *Alloprosallocrinus*, but the supposition is the merest guess of a possibility, without any facts to support it. But, if true, they disappeared from the stage of living existence abruptly, immediately following the growth of the largest species and most fruitful and prolific forms, in the very middle of the subcarboniferous age.

No one can contemplate the creation of something out of nothing, or what is called special creation; hence, the theory of evolution and development of animal life. Pseudosystematists and pseudobiologists, after having examined a few fossils, draw their conclusions concerning the embryological, larval, mature and declining stages of development of genera and species; without presenting a fact or principle to support the conclusions, they rest on technical names and barren assertions. Their ideas of evolution and of the vast and incomprehensible stages of life represented in palæozoic time, are so contracted that they would have you believe they have discovered the laws and limitations, so that the ordinary schoolboy can understand and apply them to all the fossil forms that have been or may be found. In their narrow minds they have contemplated all the resources of nature during the immeasurable ages of the past. We have looked at more than fifty thousand specimens of fossil crinoids, and have carefully examined several thousands belonging to the family here under consideration, and we are free to say we have not found any embryological, larval, mature or declining stages of development. Nor has our study caused us to believe any one has or ever will find such stages represented in the tests of the fossils under consideration.

If evolution has been the course of animal life, it must have been commensurate with the lapse of geological ages, not only as represented by the deposits, but including the time indicated by the unconformability and breaks that form the dividing lines between groups of rocks. And the interruption of the course found at these dividing lines is far greater than the development or evolution found within the deposits themselves. We are not surprised, therefore, to find *Saccocrinus* and *Cylicocrinus* without progenitors or descendants. They may have emigrated or been driven by ocean currents from the homes of their ancestors to where we find the tests; and in like manner they may have been carried away to foreign climes not suited to their habits of life, where they became extinct without leaving any degenerate descendants. If such were the case, we will never see any but such natural forms as we have found. Of course the smaller specimens may have died younger than the larger ones did, but there is nothing embryological or larval in their state of development. The largest species are found, in the Niagara Group, at Chicago, Illinois, the smallest species in Indiana, and the medium-sized species in New York; but all of them occur in the middle or upper part of the Group, and they were not, therefore, ushered in at the beginning of that geological age.

What we have said of those two genera is also applicable to *Megistocrinus*, that appeared at the outset, in the middle Devonian rocks of Indiana and Michigan, with numerous species, varying in size, from the smallest to the largest and with the greatest varieties of form and structure, and then disappeared from the last half of the Devonian age, and crossed the vast lapse of time indicated by the break, between the Devonian and Subcarboniferous rocks, and reappeared, in the Chouteau Group, represented by other and different species and again reappeared by other and different species in the Burlington Group, and then disappeared forever. But there are no embryological or larval forms, nor anything in the test of the last living species to indicate a declining structure or degenerate descendant from the Devonian series. And what we said of *Saccocrinus*, *Cylicocrinus* and *Megistocrinus* may be said with equal force of *Blairocrinus*, *Sampsonocrinus*, *Shumardocrinus*, *Agaricocrinus*, *Batocrinus*, and *Dorycrinus*. If this manner of reasoning is at all admissible, with what show can we say that from *Gennæocrinus* arose *Actinocrinus* and *Amphoracrinus?* Is it not the merest guess upon the most remote possibity?

The theory of evolution does not mean that animal life was continually improving in any or all of the channels of its existence, nor that it was declining when not improving. Neither did it pass through cycles from the embryo to senility, in genera, families, orders or classes. On the contrary, if of any value as a theory, the evolution must conform to what we find in nature, and that is almost ceaseless change, without necessarily involving advancement or decline; but conformability, with environment and surroundings. And we do not find what we call advancement or a higher degree of development, neither do we find a decline or degradation, in the family of the *Actinocrinidæ*, from its appearance in the Upper Silurian, to its disappearance, in the St. Louis Group. Nor do we find any development to a higher or decline to a lower stage of existence, in any of the genera or species, during all that period. The species are the most abundant in the Burlington Group, and the variations within specific limits, are more numerous there than elsewhere. And, having fixed upon certain characters, which we call specific, we observe, where species are most abundant and fruitful, the greatest tendency to break over these lines, so as to leave it doubtful, sometimes, whether a particular form should be regarded as a variety of a described species or as a distinct species. This occurs among the *Megistocrinus*, in the Hamilton Group, and among the *Batocrinus*, in the Burlington and Keokuk Groups; but we do not see in it any progress toward senility of the species or the reverse. In fact, we do not know whether ornamentation of the test indicates strength or weakness. We do not know whether *Megistocrinus ornatus* with its delicate sculpturing is in a higher or lower stage of development than *M. spinosulus*, with its canopy of spines; nor whether *Batocrinus nodulosus*, with its proboscis, ornamentation and tumid plates is in a higher or lower stage of development than *B. oblatus*, with plane, smooth plates and no proboscis. We do not know whether *B. oblatus* with its twenty-two arms is in a higher or lower stage of development than its congener *B. rotundus*, with twenty one arms. In short, we do not know what, if any, specific characters, in any of the genera, indicate progress or decline, though we may notice that *Batocrinus*, having tumid plates, are more abundant and have a greater geological range than those with smooth plates, and that twenty-armed species are more common than thirteen armed spicies. We must not drift away from our mooring and forget that we have seen only a small part of what the rocks have preserved, and that it is possible, for others, in future, to see a thousand times as many specimens as we have, with corresponding advantages for examining the structure, and drawing conclusions as to the evidences of development. We attempt to speak only from the present state of science and our own investigations.

FAMILY POTERIOCRINIDÆ.

BARYCRINUS SAMPSONI, n. sp.

Plate IV, Fig. 1, basal view; Fig. 2, azygous side; Fig. 3, opposite view.

Species large, robust. Calyx about one and a half times as wide as high. Plates very thick and highly convex. Angles of sutures without pits. Column rather small, as shown by the cicatrix. Surface, apparently smooth, probably granular.

Basals small and form a low, pentagonal cup or disc, with reentering angles. It is pierced by a small columnar canal, surrounded by a cicatrix, for the attachment of the column, having a diameter a little more than one-third the greatest diameter of the disc. The cicatrix bears five rounded, concave, radiately lined depressions for the firmer adherence of the column. The plates are quadrangular, without counting the side that abuts upon the canal, and the adjoining sutures are beveled, so that the form of the convexity of the plates is somewhat pyramidal. Subradials about four times as large as the basals, as long as wide, highly tumid, three hexagonal, two heptagonal, by reason of abutting the small, intercalated, azygous plate, and the other octagonal, by reason of abutting the two azygous plates. First radials about twice as large as subradials, one-fourth wider than high, remarkably thick, and broadly and deeply excavated for the attachment of the second radials. The facet has an inclination of nearly forty-five degrees.

The first radials are truncated, at the superior lateral angles, by single interradial plates. A small, triangular, elongated, azygous plate is intercalated between the subradials and below the first radial, on the right of the azygous area. Another quadrangular azygous plate, longer than wide, broadly truncates a subradial and separates two first radials. These two azygous plates do not come together.

This species is distinguished by the rapid increase in size from the basals to the first radials. By the great thickness and convexity of the plates, without angular pits. Inclined facet for the second radials, and by the azygous plates.

Found by F. A. Sampson, in whose honor we have proposed the specific name, in the Burlington Group, at Sedalia, Missouri, and now in his collection.

POTERIOCRINUS BOZEMANENSIS, n. sp.

Plate V, Fig. 11, side view, natural size, showing part of the proboscis; Fig. 10, same magnified two diameters. The specimen is on a slab.

Species very small. Calyx obconoidal, one-third wider than high. Plates rounded, with the slightest convexity, but showing the sutures. Surface apparently smooth. Column small.

Basals small and extended but little beyond the column. Subradials two or three times as large as the basals and nearly as long as wide. First radials very little if any larger than the subradials, a little wider than long, and truncated the entire width above for the first arm plates, from which they are separated by a very slightly gaping suture. The arms do not bifurcate, and hence there are only five arms in this species. The first plate is very long and round externally, but the plates rapidly shorten and bear alternate pinnules.

The azygous area is not exposed in our specimen, but from the form of the calyx and the piece of the proboscis that is exposed there can be little or no doubt of the generic relations. The part of the proboscis which is exposed and illustrated is round and composed of four series of plates.

This is a peculiar species, and so different from all others that no comparison with any of them is necessary.

Found by Earl Douglass in the subcarboniferous rocks of Bridger mountains, near Bozeman, Montana, and now in the collection of S. A. Miller.

POTERIOCRINUS DOUGLASSI, n. sp.

Plate V, Fig. 16, side view, with the azygous area on the right; Fig. 17, same magnified two diameters. The specimen is on a slab.

Species small. Calyx short, obconoidal, one third wider than high. Plates convex; sutures distinct. Surface granular. Column rather large, round, every alternate plate projecting.

Basals form a low cup that is truncated for the column and expanded above. Subradials larger than the basals and nearly as long as wide. First radials as much larger than the subradials as the subradials are larger than the basals, wider than long, pentagonal, truncated the entire width above, and separated from the second radials or brachials by a gaping suture. A single, elongated, brachial or second radial, rounded and contracted in the middle, and axillary, supports upon its superior sloping sides, in each radial series, the free arms. The arms do not again bifurcate, and hence there are ten arms in this species. The arms are composed of very long, slightly constricted plates, that alternately project on each side, for the support of coarse, long-jointed pinnules.

The first azygous plate cannot be seen in our specimen. The second plate is large, truncates a subradial and extends as high as the middle of the first brachial. The plate succeeding it is much smaller; only part of the alternate plate on the right can be seen, but enough is exposed to show the usual alternate arrangement that characterizes this genus.

This species is distinguished by the form of the calyx, single brachials and structure of the arms. While it is not conspicuously marked by any peculiar feature, yet we do not know of any species with which it might be confounded.

Found by Earl Douglass, on the Bridger mountains, at Bozeman, Montana, and the name is in honor of the collector. The specimen illustrated is in the collection of S. A. Miller.

radials. The facet has an inclination of nearly forty-five degrees.

The first radials are truncated, at the superior lateral angles, by single interradial plates. A small, triangular, elongated, azygous plate is intercalated between the subradials and below the first radial, on the right of the azygous area. Another quadrangular azygous plate, longer than wide, broadly truncates a subradial and separates two first radials. These two azygous plates do not come together.

This species is distinguished by the rapid increase in size from the basals to the first radials. By the great thickness and convexity of the plates, without angular pits. Inclined facet for the second radials, and by the azygous plates.

Found by F. A. Sampson, in whose honor we have proposed the specific name, in the Burlington Group, at Sedalia, Missouri, and now in his collection.

POTERIOCRINUS BOZEMANENSIS, n. sp.

Plate V, Fig. 11, side view, natural size, showing part of the proboscis; Fig. 10, same magnified two diameters. The specimen is on a slab.

Species very small. Calyx obconoidal, one-third wider than high. Plates rounded, with the slightest convexity, but showing the sutures. Surface apparently smooth. Column small.

Basals small and extended but little beyond the column. Subradials two or three times as large as the basals and nearly as long as wide. First radials very little if any larger than the subradials, a little wider than long, and truncated the entire width above for the first arm plates, from which they are separated by a very slightly gaping suture. The arms do not bifurcate, and hence there are only five arms in this species. The first plate is very long and round externally, but the plates rapidly shorten and bear alternate pinnules.

The azygous area is not exposed in our specimen, but from the form of the calyx and the piece of the proboscis that is exposed there can be little or no doubt of the generic relations. The part of the proboscis which is exposed and illustrated is round and composed of four series of plates.

This is a peculiar species, and so different from all others that no comparison with any of them is necessary.

Found by Earl Douglass in the subcarboniferous rocks of Bridger mountains, near Bozeman, Montana, and now in the collection of S. A. Miller.

POTERIOCRINUS DOUGLASSI, n. sp.

Plate V, Fig. 16, side view, with the azygous area on the right; Fig. 17, same magnified two diameters. The specimen is on a slab.

Species small. Calyx short, obconoidal, one third wider than high. Plates convex; sutures distinct. Surface granular. Column rather large, round, every alternate plate projecting.

Basals form a low cup that is truncated for the column and expanded above. Subradials larger than the basals and nearly as long as wide. First radials as much larger than the subradials as the subradials are larger than the basals, wider than long, pentagonal, truncated the entire width above, and separated from the second radials or brachials by a gaping suture. A single, elongated, brachial or second radial, rounded and contracted in the middle, and axillary, supports upon its superior sloping sides, in each radial series, the free arms. The arms do not again bifurcate, and hence there are ten arms in this species. The arms are composed of very long, slightly constricted plates, that alternately project on each side, for the support of coarse, long-jointed pinnules.

The first azygous plate cannot be seen in our specimen. The second plate is large, truncates a subradial and extends as high as the middle of the first brachial. The plate succeeding it is much smaller; only part of the alternate plate on the right can be seen, but enough is exposed to show the usual alternate arrangement that characterizes this genus.

This species is distinguished by the form of the calyx, single brachials and structure of the arms. While it is not conspicuously marked by any peculiar feature, yet we do not know of any species with which it might be confounded.

Found by Earl Douglass, on the Bridger mountains, at Bozeman, Montana, and the name is in honor of the collector. The specimen illustrated is in the collection of S. A. Miller.

FAMILY RHODOCRINIDÆ.

GONIASTEROIDOCRINUS FABERI, n. sp.

Plate V, Fig. 2, basal view; Fig. 3, side view.

Species large. Calyx subcylindrical to near the summit where it curves outward. No radial ridges. Basal plates depressed. The other plates tumid, nodose or spinous. Our specimen is a cavity in a rock, preserving all the external features of the calyx, except the sutures between the basal plates, and by taking an impression from it the artist has been able to furnish a basal and side view.

The basal plates form a regular pentagon one-half wider than the diameter of the column. The columu is round. Subradials large, almost regularly hexagonal, and each one bears a long, sharp, conical spine, that is directed downward, at an angle of about forty-five degrees. The calyx will rest upon the points of these spines. First radials a little smaller than the subradials, wider than long, heptagonal, and each one bears a long, sharp, conical spine that is directed horizontally. Second radials about one-fifth as large as the first, convex, quadrangular and longer than wide. Third radials about twice as large as the second, tumid, octagonal, and support on each superior lateral side two secondary radials. The superior face is truncated by an intersecondary plate that is followed by two plates in the second range. The calyx curves out rapidly, from the third primary radials, and the secondary radials spread, so that at the summit of the second secondary radials, they are directed laterally at an angle of about forty-five degrees. Beyond this point our specimen is not preserved. These plates are subnodose.

There are ten plates shown in an interradial area in our specimen, and we suppose that to be the limit. The first plate is almost in line with the first primary radials and about two-thirds as large, hexagonal, and bears a long, sharp, conical spine that is directed horizontally. It is followed by three smaller, subequal plates in the second range, each one of which bears a large central node; and these are followed by three still smaller plates in the third range, each one of which bears a central node. Above these there are three plates shown in our specimen, each one of which bears a small central node.

On the slab, which is chert, containing our specimen there are the casts of what we suppose to be part of the pseudo ambulacral appendages or ovarian extensions, but they are not connected with the calyx, and for that reason are not illustrated. If they represent these appendages, they are much larger than any belonging to any of the described species of *Goniasteroidocrinus.*

Found in Subcarboniferus rocks, probably of the age of the Keokuk Group, near Joplin, Missouri, and now in the collection of Charles L. Faber.

FAMILY CYATHOCRINIDÆ.

CYATHOCRINUS FABERI, n. sp.

Plate V, Fig. 12, basal view; Fig. 13, azygous side; Fig. 14, opposite view; Fig. 15, radial plate magnified two diameters.

Specimens medium size. Calyx about twice as wide as high, somewhat obconoidal, most expanded on the azygous side. Sutures distinct. Surface pustulous, the pustules sometimes uniting so as to form lines. Column round, medium size.

Basals small and form a low cup, with a shallow, concave depression for the attachment of the column. Subradials nearly as long as wide, the one on the azygous side being the largest. First radials of unequal size and from one-half wider than long to more than twice as wide as long, and truncated the entire width above for the second radials. The facets are inclined, indicating a gaping suture, and they are only slightly notched for the ambulacral canals. The azygous plate truncates a subradial and extends one-third of its length above the first radials.

This species is distinguished by its form and pustulous surface from all other illustrated species. There have been several species, in this genus, described without illustrations, and we have compared this species with the definitions, some of which are very unsatisfactory, but none of them seem to be like this one.

Found in the Burlington Group, at Burlington, Iowa, and now in the collection of Charles L. Faber, in whose honor we have proposed the specific name.

FAMILY PLATYCRINIDÆ.

PLATYCRINUS DOUGLASSI, n. sp.

Plate V, Fig. 18, side view; Fig. 19, same magnified two diameters. The specimen is compressed so as to appear wider than it really is.

Species medium or below medium size and belonging to the round, bowl-shaped forms. Calyx round, bowl-shaped, truncated below, and, when not compressed, about as high as wide. Sutures are not beveled. There is a constriction just above the base so as to form a basal rim. The surface is furrowed transversely across the sutures between the first radials and longitudinally from the lower part of the facet for the second radials across the basal plate, but increasing in number, so as to cover the basal plates to the constriction above the basal rim. These furrows do not cross each other. The column is small and elliptical.

Basals form a low cup rather more than one-third the height of the calyx. First radials longer than wide and increasing in width very slowly in their upward extension, so that the calyx increases in width very little above the basals. Articulating facets for the second radials very slightly excavated, about one third the width of the plates. Second radials very short or transversely almost linear. Third radials short, axillary, and bear, upon each upper sloping side, the free arms. There are, therefore, ten arms in this species. The arms are long, slender, composed of projecting, cuneiform plates, bearing pinnules alternately. The pinnules are long and very dense. Our specimen is on a slab and there are fragments of the arms not illustrated, which show the unusual density of the pinnules.

The superior face of the first radials is transverse, without showing any evidence of interradials. Vault unknown.

This is a peculiar species, distinguished by its form and surface ornamentation from all others.

It was found by Earl Douglass, in whose honor we have proposed the specific name, on Bridger Mountains, near Bozeman, Montana, and now in the collection of S. A. Miller. The rocks from which it was collected are subcarboniferous.

FAMILY GLYPTASTERIDÆ.

GLYPTASTER MILLIGANÆ, n. sp.

Pate V, Fig. 7, azygous side of a small specimen; Fig. 8, side view of a larger specimen; Fig. 9, summit view of same.

Species variable in size. Calyx obpyramidal, truncated below only the size of the column. Plates highly convex. Radial ridges imperfectly defined. Higher than wide. Interradial areas flattened below and depressed between the arms. Surface smooth or finely granular. Column pentagonal. Columnar canal small and slightly cinquefoil.

Basals form a small pentagonal disc, with the angles directed toward the center of the subradials. Subradials large, longer than wide, having an angular ridge directed toward the center of each adjoining first radial and one toward an angle of the basal disc. A transverse section is pentagonal, with the angles at the center of the subradials, and re-entering angles at the sutures, as in the basal disc below; but from the center of the first radials upward, a transverse section is pentagonal, with the center of the radials in the angles. First radials rather larger than the subradials and a little wider than long. The one on the left of the azygous area hexagonal, the others heptagonal. Second radials much smaller and hexagonal. Third radials smaller than the second, axillary and support the free arms.

The first regular interradials are large, rest between the superior sloping sides of the first primary radials, and are followed by two much smaller plates in the second range, which unite with smaller plates that graduate to those of the vault, without any distinct line of separation. One can hardly say whether or not the third range should be classed with the plates of the vault. The first azygous plate truncates a subradial, and is followed by three plates in the second range, that unite with plates which should, probably, be classed with those of the vault.

The vault is depressed, convex toward the center and sunken toward the interradial areas. It is covered with numerous convex, polygonal plates, and bears a subcentral azygous orifice. There is a slight swelling, commencing at the margin, in the azygous area and extending beyond the azygous orifice, that is covered with very small plates.

This is a marked and peculiar species, that cannot be mistaken for any hitherto described.

Found by Mrs. J. M. Milligan, of Jacksonville, Illinois, in whose honor we have proposed the specific name, in the Niagara Group, of Decatur county, Tennessee, and now in her collection.

FAMILY EUCALYPTOCRINIDÆ.

EUCALYPTOCRINUS MILLIGANÆ, n. sp.

Plate V, Fig. 4, basal view; Fig. 5, side view showing the constriction of the calyx; Fig. 6, side view of another specimen showing the sutures separating the interradials from the summit plates and constriction of the latter above the arms, the azygous orifice being at the top.

Species medium size. Calyx subturbinate, broadly constricted, in the middle part, and truncated at the base, Surface smooth or granular, our specimens being silicified the granules, if they ever existed, are destroyed. Column small and round.

Basals within the calyx and with the inferior part of the first radials form a pentagonal, funnel-shaped cavity for the reception of and attachment of the column. First radials wider than long, abruptly curved into the basal concavity, and upward, on the outside, so as to form a sharp, pentagonal rim at the base of the calyx. Second radials quadrangular, less than one-half wider than long. Third radials somewhat larger than the second, heptagonal, and support on each upper lateral side, two secondary radials, the last being axillary and supporting, upon its nearly transverse upper face, two arms. Above three or four transverse plates, the arms are composed of a double series of interlocking plates, as in other species. The outline of each arm, however, is more fusiform than usual.

The superior point of each third primary radial is truncated by a pair of elongated interbrachials as in the regular interbrachial areas, and these are followed by a long plate that is divided internally, and extends to the top of the arms where it unites with a summit plate. The first regular interradial is of moderate size, ten sided, and followed by two elongated plates in the second range, and those by a long plate that is divided internally and extends to the top of the arms where it unites on either side with a summit plate. The arms when closed are compact, within furrows formed by the internal union of the long interbrachial plates. There are five plates at the summit that form a vault, which is constricted above the tops of the arms, and bears a central azygous orifice. This structure of the summit may be of generic importance, and, if so, this species would belong to *Hypanthocrinus*. We doubt the propriety, however, of founding any genus of crinoids, on the structure of the vault or proboscis, and, therefore, refer this species to Eucalyptocrinus.

This species is distinguished by the pentagonal, funnel-shaped, columnar cavity, broadly constricted calyx, fusiform arms, constricted vault and elevation of the azygous orifice.

Found by Mrs. J. M. Milligan, in whose honor we have proposed the specific name, in the Niagara Group, in Decatur county, Tennessee, and now in her collection, in Jacksonville, Illinois.

ORDER BLASTOIDEA.

FAMILY CODASTERIDÆ.

CODASTER JESSIEÆ, n. sp.

Plate V, Fig. 20, basal view; Fig. 21, side view; Fig. 22, summit.

Calyx about one-fifth wider than high. Summit only moderately convex. Transverse section of the basals subtriangular, with concave sides. Transverse section above the basals subpentagonal. Surface without ornamentation.

Basals occupy nearly half the height of the calyx. They are longitudinal, depressed at the sutures and rounded in the middle part of each plate. The point for the attachment of the column is exceedingly small. The two larger plates are of equal size and pentagonal, the smaller one is tetragonal. Radials equal, wider than long and the mesial gibbosity gives the pentagonal outline to the summit. Part of the summit is destroyed in our specimen and hence only part of it can be described. The pseudoambulacra are very narrow and there are only five hydrospire slits in an area.

This species is distinguished by its general form and smooth surface. The depressed sutures between the basals is a distinguishing feature, and so are the five hydrospire slits in an area.

Found by Miss Jessie Blair, in the Choteau limestone, at Sedalia, Missouri, and now in the collection of S. A. Miller. The specific name is given as a compliment to the finder.

CLASS CRUSTACEA.

SUB-CLASS XIPHOSURA.

ORDER EURYPTERIDA.

FAMILY EURYPTERIDÆ

EURYPTERUS KOKOMOENSIS, n. sp.

Plate V, Fig. 1. the lower or ventral side of a nearly complete specimen.

This species seems to be about the size of *Eurypterus remipes*, but differing somewhat in the relative proportions of the body. The carapace is roundish or somewhat quadrangular with the anterior corners rounded and about seven-eighths as long as wide. The abdomen gradually widens from the carapace for three or four articulations and then contracts gradually to the last segment, or it may be said to be somewhat evenly rounded laterally. The posterior projections or angles of the segments are only partially preserved in our specimen, until the last segment is reached, and here they appear much larger than is usual, in this genus. There are twelve segments. Telson tapers slowly to near the end when it rapidly tapers to the point. The length of the telson is about two-ninths of the entire length of the animal.

There are only two pair of the palpi preserved, in our specimen, and they appear, as shown in the illustration. The limestone rock is disposed in thin layers and others may have been broken away without leaving a trace of their former existence. The pair of swimming feet are unusually large, but the specimen preserves little more than a bare outline of them. The mouth too is indistinct but the outline of the small post oral plate is preserved.

This species is distinguished from all others by the greater length of the carapace in proportion to its diameter and by the shorter telson. These characters are obvious. Its general form will readily distinguish it also.

Of course, if it never had but two pair of palpi, this would be a very marked and important distinction; but the parts preserved are so much like *Eurypterus*, that we suppose there were four pair and two have not been preserved.

Found in the Waterline Group, at Kokomo, Indiana, and now in the collection of Wm. F. E. Gurley.

PLATE I.

Page.

Agaricocrinus sampsoni, n. sp. 5
Fig. 1. View opposite the azygous side.
Fig. 2. Azygous side on the right.

Agaricocrinus pettisensis, n. sp. 6
Fig. 3. Azygous view.
Fig. 4. Opposite view.

Physetocrinus sampsoni, n. sp. 14
Fig. 5. Azygous view.
Fig. 6. Opposite view.
Fig. 7. Summit.

Dorycrinus parrishi, n. sp. 19
Fig. 8. Azygous view.
Fig. 9. Opposite view.
Fig. 10. Summit.

Batocrinus nodosarius, n. sp. 23
Fig. 11. Lateral view, azygous side to the right.
Fig. 12. Summit.

Batocrinus levis, n. sp 23
Fig. 13. Basal view.
Fig. 14. Azygous view.
Fig. 15. Summit.

Batocrinus enodis, n. sp. 25
Fig 16. Basal view.
Fig. 17. Azygous view.
Fig. 18 Summit.

Batocrinus complanutus, n. sp. 27
Fig. 19. Azygous view.
Fig. 20. Opposite view.

Batocrinus levigatus, n. sp. 29
Fig. 21. Azygous view.
Fig. 22 Opposite view.

Batocrinus politus, n. sp. 31
Fig. 23. Basal view.
Fig. 24. Azygous view.
Fig. 25. Summit.

Batocrinus glaber, n. sp. 32
Fig. 26. Azygous view.
Fig. 27. Opposite side of the same.
Fig. 28. Opposite side of another specimen.

ILL. STATE MUS. OF NAT. HIST.

Bulletin No. 10. **Plate I.**

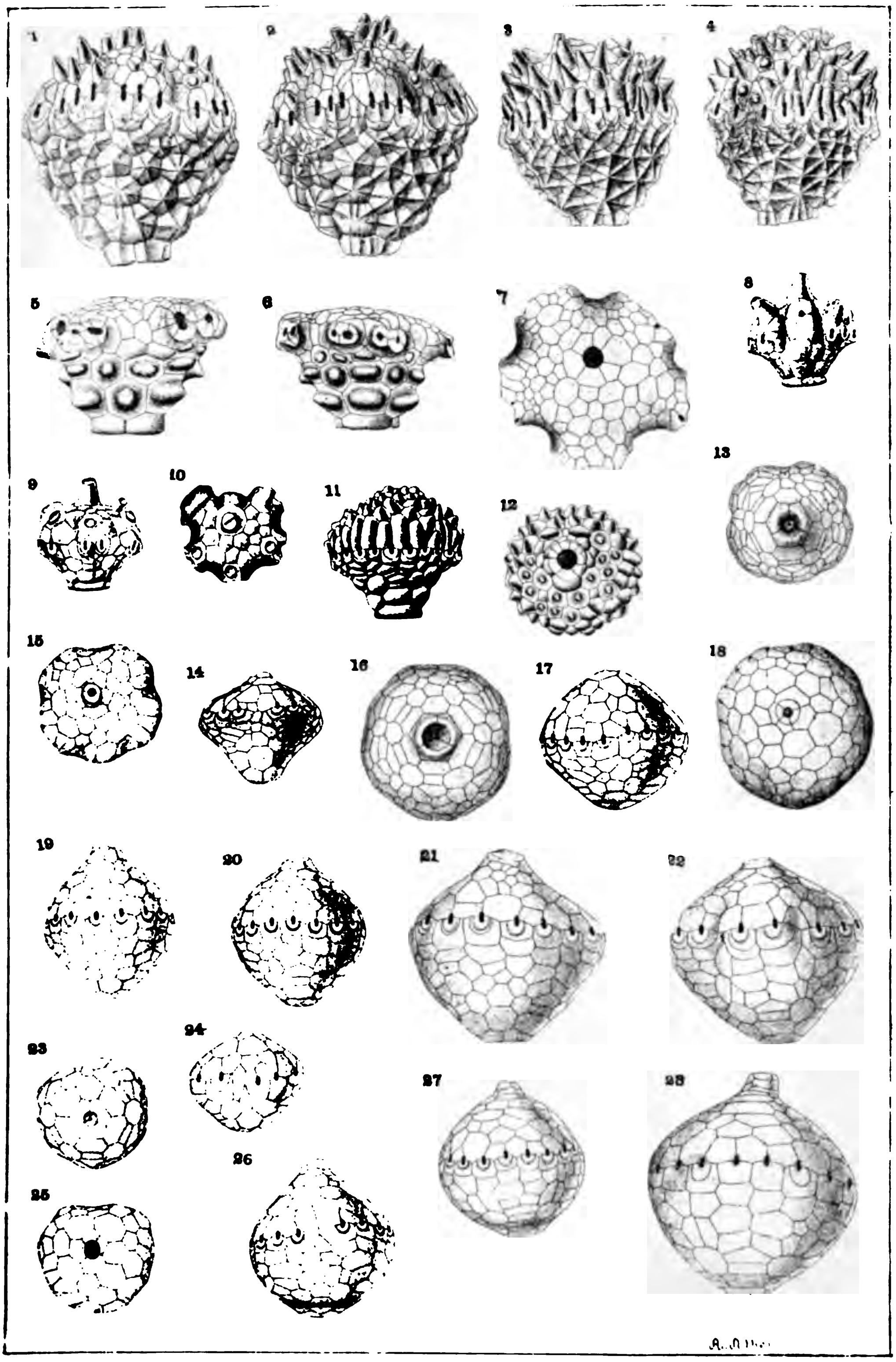

PLATE II.

Page.

Batocrinus insolens, n. sp. 35
  Fig. 1. Azygous view.
  Fig. 2. Opposite view.

Batocrinus selectus, n. sp. 37
  Fig. 3. Azygous view.
  Fig. 4. Opposite view.
  Fig. 5. Summit.

Batocrinus albersi, n. sp. 38
  Fig. 6. Azygous view.
  Fig. 7. Basal view.
  Fig. 8. Summit.

Batocrinus saccellus, n. sp. 40
  Fig. 9. Azygous view.
  Fig. 10. Opposite view.
  Fig. 11. Summit.

Batocrinus sublevis, n. sp. 41
  Fig. 12. Azygous view.
  Fig. 13. Opposite view.
  Fig. 14. Summit.

Batocrinus remotus, n. sp 43
  Fig 15. Azygous view.
  Fig. 16. Opposite view.
  Fig. 17. Summit.

Batocrinus repositus, n. sp. 45
  Fig. 18. Azygous view.
  Fig 19. Opposite view.
  Fig. 20. Summit.

Batocrinus enodatus, n. sp. 46
  Fig. 21. Azygous view.
  Fig 22. Basal view.
  Fig. 23. Summit.

Batocrinus speciosus, n. sp. 47
  Fig. 24. Azygous view.
  Fig. 25. Opposite view.
  Fig. 26. Summit.

Batocrinus subrotundus, n. sp 48
  Fig. 27. Basal view.
  Fig. 28. Summit.
  Fig. 29. Azygous view.

Batocrinus subovatus, n. sp 50
  Fig. 30. Azygous view.
  Fig. 31. Opposite view.

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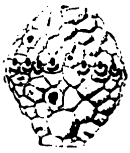
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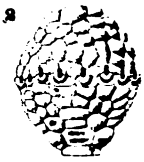
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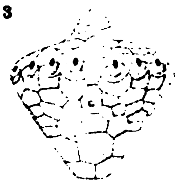
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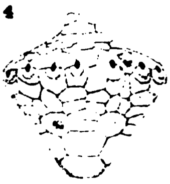
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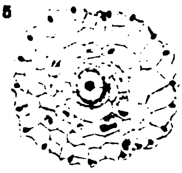
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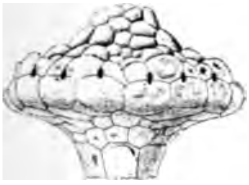
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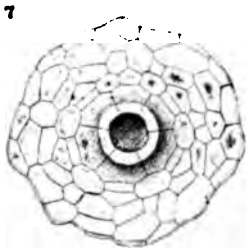
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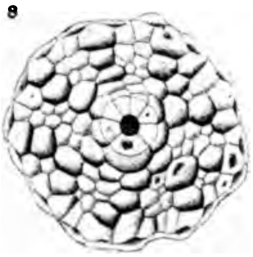
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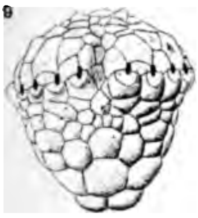
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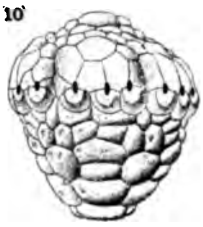
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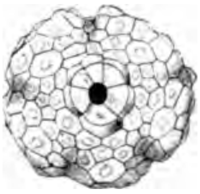
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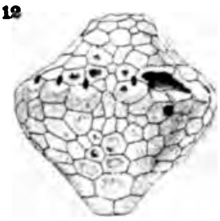
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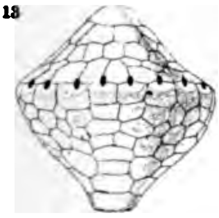
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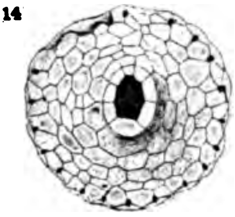
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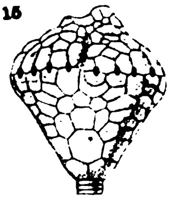
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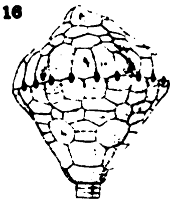
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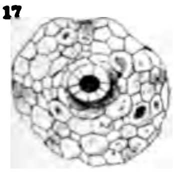
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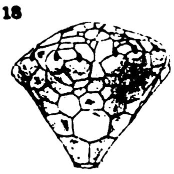
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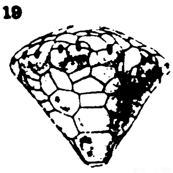
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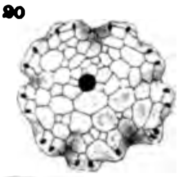
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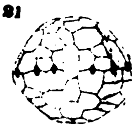
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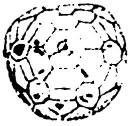
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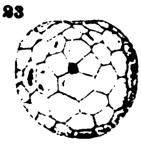
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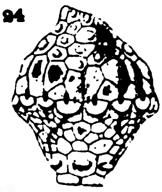
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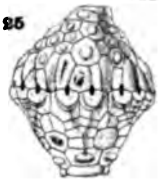
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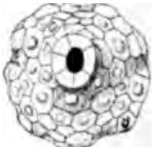
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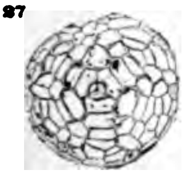
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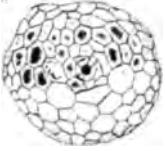
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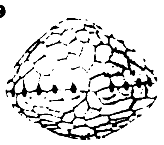
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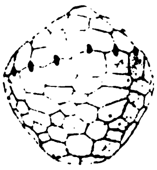
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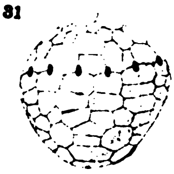

A. Albers

PLATE III.

Page.

Actinocrinus bischoffi, n. sp. 8
  Fig. 1. Azygous view.
  Fig. 2. Opposite view.

Actinocrinus spectabilis, n. sp. 9
  Fig. 3. Azygous view.

Actinocrinus sobrinus, n. sp 10
  Fig. 4. Azygous view.
  Fig. 5. Opposite view.

Batocrinus subscitulus, n. sp 12
  Fig. 6. Azygous view.
  Fig. 7. Opposite view.
  Fig. 8. Summit.

Actinocrinus subscitulus, n. sp. 51
  Fig. 9. View opposite azygous side.
  Fig. 10. Basal view.
  Fig. 11. Summit.

Actinocrinus subpulchellus, n. sp 13
  Fig. 12. Azygous view.
  Fig. 13 Opposite view.
  Fig. 14. Summit.

Dorycrinus alabamensis, n. sp 15
  Fig. 15. Basal view.
  Fig. 16. Summit.
  Fig. 17. Azygous view.

Amphoracrinus jessieæ, n. sp. 21
  Fig. 18 Azygous view.
  Fig. 19. Basal view.

Dorycrinus sampsoni, n. sp. 17
  Fig. 20. Azygous view.
  Fig. 21. Opposite view.
  Fig. 22. Summit.

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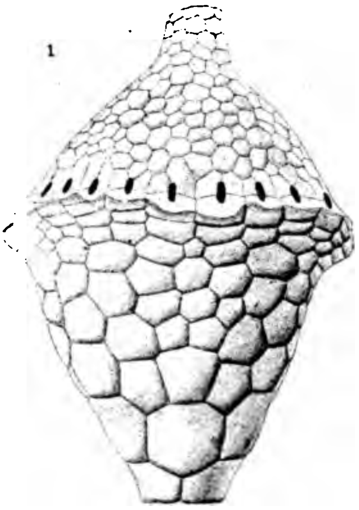

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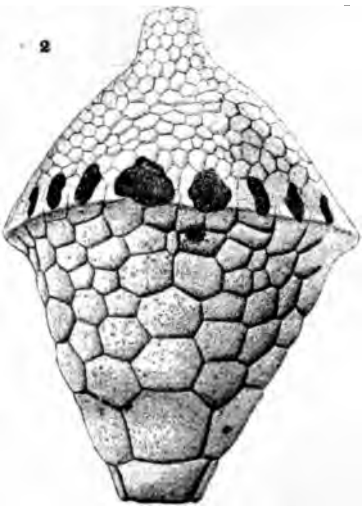

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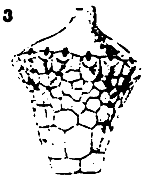

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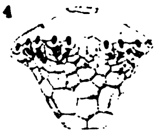

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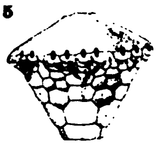

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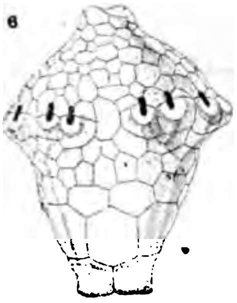

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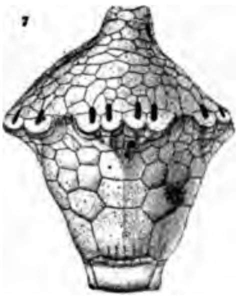

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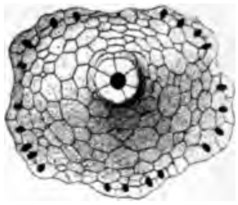

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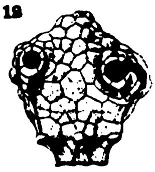

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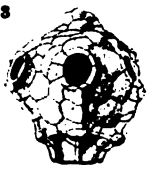

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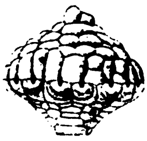

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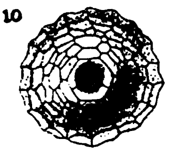

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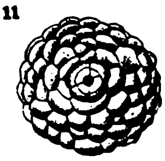

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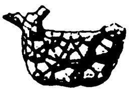

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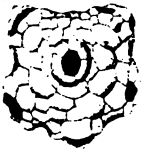

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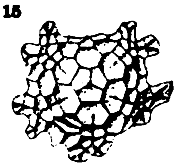

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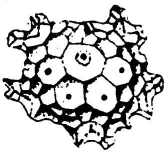

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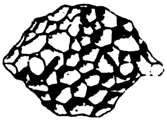

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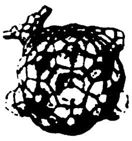

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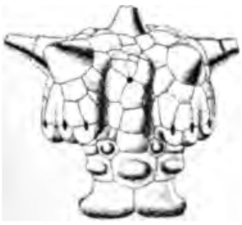

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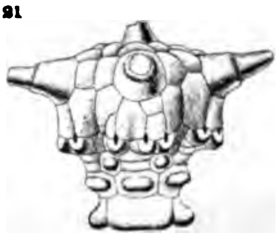

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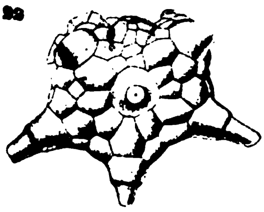

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PLATE IV.

Page.

Barycrinus sampsoni, n. sp. 51
Fig. 1. Basal view.
Fig 2. Azygous view.
Fig. 3. Opposite view.

Batocrinus rudis, n. sp. 52
Fig. 4. Azygous view.

Batocrinus sagetownensis, n. sp. 54
Fig 5. Azygous view.
Fig. 6. Opposite view.
Fig. 7. Summit.

Batocrinus affinis, n. sp. 55
Fig. 8. Azygous view.
Fig. 9. Opposite view.

Batocrinus approximatus, n sp. 56
Fig. 10. Azygous view.
Fig. 11. Opposite view.
Fig. 12. Lateral view of another specimen.

Batocrinus variabilis, n. sp. 58
Fig. 13. Azygous view of elongated form.
Figs. 14 and 15. Lateral views of same.
Figs. 16 and 17. Lateral views of another specimen.

Batocrinus cognatus, n. sp 60
Fig. 18. Azygous view.
Figs. 19, 20 and 21. Lateral views of the same.

Batocrinus consanguineus, n. sp. 62
Fig. 22 Azygous view.
Fig. 23. Opposite view.

Batocrinus (an abnormal specimen) 64
Fig. 24. Right side view.
Fig. 25. Adjoining side view.

Batocrinus (an abnormal specimen.) 66
Fig. 26. Azygous view.
Fig. 27. Opposite view.

Batocrinus repertus, n. sp 70
Fig. 28. Azygous view.
Fig. 29. Opposite view.
Fig. 30. Summit.

Batocrinus sedaliensis, n sp. 71
Fig. 31. Azygous view.
Fig. 32. Opposite view.

Batocrinus subæquatus, n. sp. 72
Fig. 33. Azygous view.
Fig. 34. Opposite view.
Fig. 35. Summit.

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Bulletin No. 10.

Plate IV.

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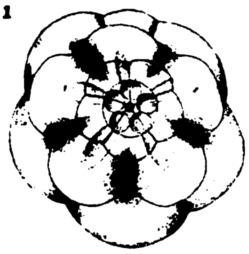

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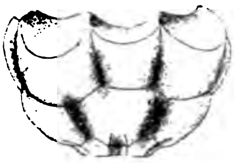

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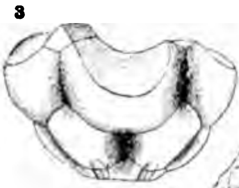

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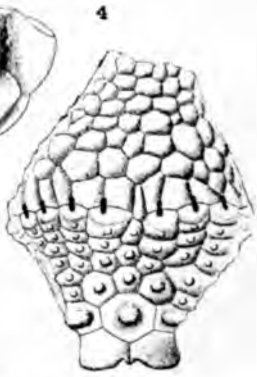

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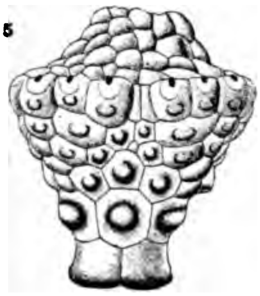

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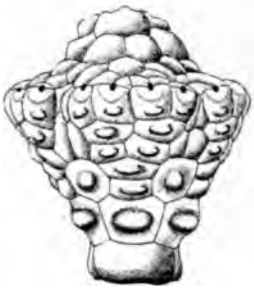

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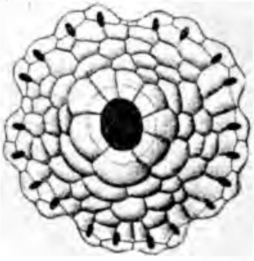

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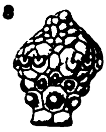

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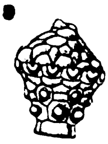

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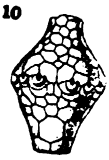

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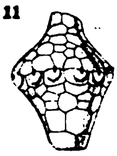

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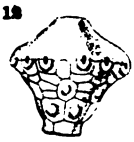

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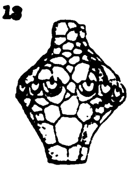

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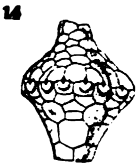

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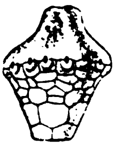

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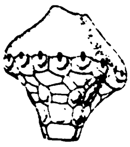

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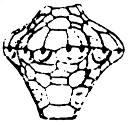

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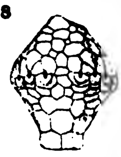

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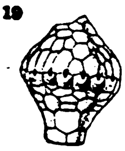

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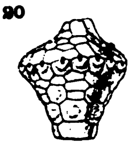

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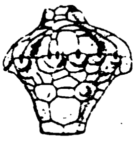

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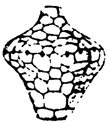

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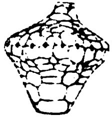

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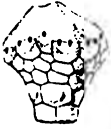

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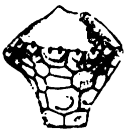

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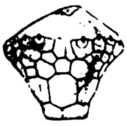

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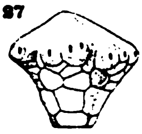

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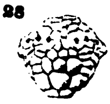

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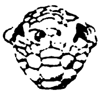

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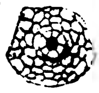

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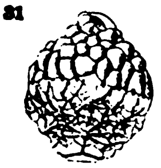

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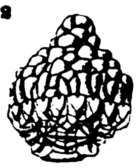

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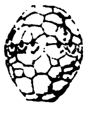

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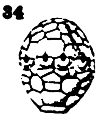

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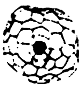

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PLATE V.

Page.

Eurypterus kokomoensis, n. sp. 90
Fig. 1. Lower or ventral view of a nearly complete specimen.

Goniasteroidocrinus faberi, n. sp. 84
Fig. 2. Basal view.
Fig. 3. Lateral view.

Eucalyptocrinus milliganæ, n. sp. 88
Fig. 4. Basal view.
Fig. 5. Lateral view.
Fig. 6. Lateral view of another specimen.

Glyptaster milliganæ, n. sp. 87
Fig. 7. Azygous view.
Fig. 8. Lateral view of a larger specimen.
Fig. 9. Summit view of same.

Poteriocrinus bozemanensis, n. sp. 82
Fig. 11. Lateral view.
Fig. 10. Same magnified two diameters.

Cyathocrinus faberi, n. sp. 85
Fig. 12. Basal view.
Fig. 13. Azygous view.
Fig. 14. Opposite view.
Fig. 15. Radial plate magnified two diameters.

Poteriocrinus douglassi, n. sp. 83
Fig. 16. Lateral view.
Fig. 17. Same magnified two diameters.

Platycrinus douglassi, n. sp. 86
Fig. 18. Lateral view.
Fig. 19. Same magnified two diameters.

Codaster jessieæ, n. sp. 89
Fig. 20. Basal view.
Fig. 21. Lateral view.
Fig. 22. Summit.

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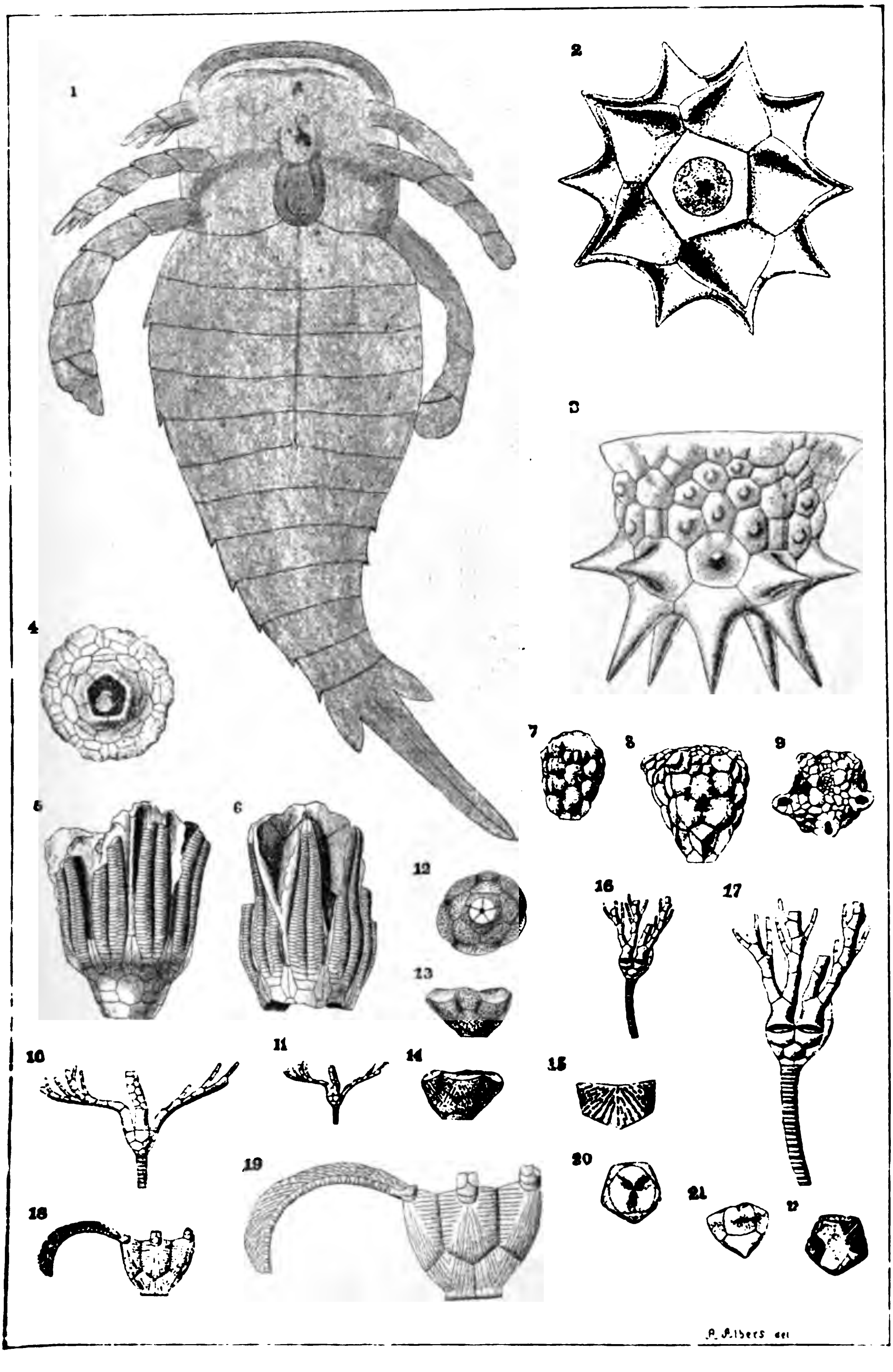
Bulletin No. 10. **Plate V.**



BULLETIN NO. 11

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BY S. A. MILLER AND WM. F. E. GURLEY.

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SPRINGFIELD, ILLINOIS.
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NEW SPECIES OF PALÆOZOIC INVERTEBRATES FROM ILLINOIS AND OTHER STATES.

BY S. A. MILLER AND WM. F. E. GURLEY.

SUBKINGDOM MOLLUSCA.

CLASS LAMELLIBRANCHIATA.

ORDER SIPHONIDA.

FAMILY CARDIIDÆ.

LUNULICARDIUM GRANDE n. sp.

Plate I, Fig. 1, right valve; Fig. 2, left valve of another specimen; Fig. 3, anterior view of same.

Shell very large, subovate. Valves highly convex or tumid. Height about one-sixth more than the length. Anterior side rounded and recurved toward the basal margin. Posterior and basal margins broadly rounded. Beaks near the middle, prominent and incurved over the cardinal line. Umbones gibbous and gradually merged into the convexity of the valves. Thickness through the greatest convexity of the valves about one-sixth less than the greatest length. Surface marked by from seventy to ninety fine radiating plications, that increase in size without division or implantation, toward the margin of the shell. Our specimens are casts but the plications are so distinct, that without careful inspection, one might suppose he was looking at the shell itself. There are some undefined concentric undulations of growth of the shells preserved on the casts.

This species is so different from any other defined *Lunulicardium* that no comparison with any of them is necessary. It may not be a *Lunulicardium* but as the hinge line and interior are unknown in any species of *Lunulicardium* it is referred to the genus, but it approaches nearer to it in external appearance than to any other genus.

Found by R. A. Blair in rocks of the age of the Hamilton Group at Providence, Missouri, and now in the collection of S. A. Miller.

LUNULICARDIUM RETRORSUM, n. sp.

Plate II, Fig. 26, right valve of large specimen; Fig. 27, left valve of small specimen; Fig. 28, cardinal view of same.

Shell small, obliquely subovate. Valve highly convex. Height about one-fourth more than the length. Anterior side recurved and merged into the basal margin. Posterior margin somewhat truncated and then gently rounded to the post basal extremity. Basal margin abruptly rounded at the post basal margin. Beaks near the middle, very prominent and incurved over the hinge line. Umbones gibbous and gradually merged into the general convexity of the valves. Thickness or width through the greatest convexity of the valves equal to the length. Surface marked by sixty or seventy fine radiating plications that increase by implantation in the umbonal region. There are also undefined concentric undulations of growth of the shells preserved on the casts. Our specimens are casts quite well preserved.

This species is distinguished by the great convexity of the valves, prominent incurving beaks and retrorse or recurved anterior margin.

Found by R. A. Blair in the Chouteau limestones, near Sedalia, Missouri, and now in the collection of S. A. Miller.

BLAIRELLA, n. gen.

Shell equivalve, inequilateral, elliptical, subovate or subcircular. Margins closed. Beaks anterior to the middle and incurved. Umbones high and merging into the general convexity of the shell below. Cardinal line straight posterior to the beaks. Ligament external and contained in a groove along the cardinal line. No cincture on the sides of the values. Surface marked by concentric undulations or concentric lines of growth. There is a concave pit beneath the beak of the right valve, anterior to which there is a single tooth and posterior to which there is a strong bifid tooth. Muscular impressions and pallial line not observed. Type B. sedaliensis.

In general form this genus most resembles *Edmondia* and if we had not found the hinge teeth and hinge line we would have contented ourselves by referring the species to that genus. But *Edmondia* has a narrow hinge and no teeth; while this genus has a wide hinge, three teeth and a pit beneath the beak, which separate the genera into distinct families. *Edmondia* is classed with the *Cardiomorphidæ* while this genus, by its internal structure, allies itself with radiately ribbed shells and may provisionally be referred to the *Cardiidæ*. The generic name is in honor of the veteran naturalist and collector R. A. Blair, of Sedalia, Missouri.

BLAIRELLA SEDALIENSIS, n. sp.

Plate I, Fig. 4, hinge line; Fig. 5, outer side of the same shell, which is eroded; Fig. 6, right valve of a cast; Fig. 7, right valve of another cast; Fig. 8, Cardinal view of the same specimen.

Shell subovate to subcircular. Length from one fifth to one fourth greater than the height. Cardinal line straight, posterior to the beaks, and more than half the length of the shell. Anterior, posterior and basal margins rounded. The posterior margin a little more acutely rounded than the anterior, and the basal margin more broadly rounded than either of them. Valves regularly convex and somewhat gibbous in the umbonal region. Width or thickness through the valves nearly equal to half the greatest length of the shell. Beaks forward of the line of the anterior third, prominent, and incurved over the hinge. Post cardinal and antero-cardinal slopes concave. Shell thick on the cardinal line and at the anterior end. Cardinal line grooved externally for the ligament. Large concave pit beneath the beak of the right valve, anterior to which, there is a long tooth, and posterior, to which, there is a strong bifid tooth. Surface marked by very numerous concentric lines of growth.

Found by R. A. Blair and also by S. A. Miller, in the Chouteau limestone, near Sedalia, Missouri, and now in the collection of S. A. Miller.

FAMILY CARDIOMORPHIDÆ.

EDMONDIA ALBERSI, n. sp.

Plate I, Fig. 9, right valve; Fig. 10, left valve of another specimen; Fig. 11, cardinal view of same specimen with point of beak of left valve broken off, and beak at right valve broken off.

Species rather large, six specimens at hand, one smaller and one larger than either one illustrated. Shell subcircular, our specimens are casts, and the length and height are subequal. Cardinal line is gently curving, anterior end somewhat sharply rounded, posterior end subtruncate, shell most produced at the posterior lower margin. Beaks a little forward of the central part, high, and curving over the cardinal line. Umbones high, anterior and posterior sides subangular, the angularity merging below into the general convexity of the shell. Valves somewhat gibbous in the middle part. Pallial line curves quite regularly and is near the margin. Surfaces of the casts retain the evidences of five concentric lines on the shell.

We have little doubt about the generic reference of this species, though the hinge is unknown, and it bears no near resemblance, in form, to any other described species.

Found by R. A. Blair, in the Chouteau limestone, at Sedalia, Missouri, and now in the collection of S. A. Miller. The specific name is in honor of Mr. A. Albers, a very good palæontologist as well as an excellent artist.

CHÆNOMYA LONGA, n. sp.

Plate I, Fig. 12, cardinal view; Fig. 13, left valve.

Species medium size. Shell more than three times as large as high. Cardinal line concave, less than half the length of the shell. Ligament external. Anterior end narrowly rounded and closed. Posterior end widely gaping, dilated and produced nearly half the length of the shell, from the end of the hinge line, to the postero-basal margin. Basal margin nearly straight, though slightly constricted in the middle part. Beaks near the anterior end, somewhat acute and incurved. Umbonal area depressed and from which arises a broad undefined cincture, that extends to the basal margin. Post umbonal slope angular, but gradually loses the angularity, posterior to the end of the hinge line, and merges into the general convexity of the shell, toward the post-basal extremity. Dorsal side of each valve flattened and inclined from the post umbonal slope to the external ligament. Surface marked by strong concentric lines of growth below the post umbonal slope but between that and the hinge line the concentric lines are much smaller.

This is a marked species and no comparison with any other is necessary.

Found by R. A. Blair, in the Chouteau limestone, near Sedalia, Missouri, and now in the collection of S. A. Miller.

SPHENOTUS SINUATUS, n. sp.

Plate II, Fig. 29, right valve of large specimen; Fig. 30, left valve of a smaller specimen believed to belong to the same species.

Specimens variable, in size, from one-half as large as the smaller one illustrated to one-fourth larger than the larger illustration. Shell trapezoidal. Cardinal line straight or slightly arched. Anterior end gently rounded below the beaks. Posterior margin obliquely truncate and then rounded into the basal margin. Basal margin broadly and slightly constricted in the middle part. Valves depressed convex on the sides but more gibbous in the umbonal region. Length twice as great as the height. Beaks at the anterior end, small, flattened and appressed. Umbones angular from the beak down the posterior slope to the post inferior extremity. Post cardinal slope convex and marked along the center by a median angular ridge, in some specimens, and by two median ridges separated by a concave furrow in others, which extend to the lower end of the oblique truncation of the posterior margin. On our larger specimens, which we regard as the types of the species, there are two median ridges, on the posterior cardinal slope, and only one, on the smaller specimens. Cincture oblique and extends from the beak to the constriction in the basal margin. Surface marked by concentric lines of growth. All of our specimens are casts. No part of the shell is preserved.

This is a marked species and no comparison with any other is necessary.

Found by R. A. Blair, in the Chouteau limestone, near Sedalia, Missouri, and now in the collection of S. A. Miller.

ORDER ASIPHONIDA.

FAMILY ARCIDÆ.

MACRODON FACETUS, n sp.

Plate I, Fig. 14, cardinal view; Fig. 15, right valve, both ends of the specimen are broken; Fig. 16, surface of the cast magnified six diameters.

Species small Our specimens are casts but part of the surface markings of the shell are preserved. Shell elongate, about or more than twice as long as high; highest about the anterior third. Valves convex and thickness about equal to the height. Cardinal line straight and a little short of the greatest length of the shell. Anterior end angular at the cardinal line and then rounded into the basal margin. Posterior end obliquely truncated, from the end of the cardinal line, and then narrowly rounded, at the post-basal extremity, into the basal margin. Basal margin broadly and somewhat evenly rounded. Beaks near the anterior end and incurved above the hinge line. Umbones prominent and fading into the general convexity of the shell. Post-umbonal slope subangular and extending to the post-basal extremity. No cincture. Cardinal slope concave. Surface marked by concentric lines of growth that are plainly visible to the unaided eye, and by fine radiating striæ that give a beautiful cancellated structure to the cast under an ordinary magnifier. This surface ornamentation is doubtless plainly visible on the shell itself.

This species will be readily distinguished by its general form, obliquely truncated, posterior end, concave cardinal slope and surface ornamentation.

Found by R. A. Blair in the Chouteau limestone, near Sedalia, Missouri, and now in the collection of S. A. Miller.

MACRODON PETTISENSIS, n. sp.

Plate II, Fig. 17, right valve; Fig. 18, right valve of a larger specimen, with the anterior end broken off.

Species below medium size. Shell subelliptical or subovate, wider behind. Length about one and two-thirds the height. Cardinal line straight and almost equaling the greatest length of the shell. Anterior end gently rounded into the basal margin. Posterior end somewhat subtruncated in the upper part and rounded into the basal margin. The basal margin in the subelliptical specimens is broadly rounded, but, in the subovate specimens, the postero-basal margin is somewhat produced and more abruptly rounded. Valves compressed or only moderately convex. Beaks a little anterior to the middle, obtuse and rising slightly above the cardinal line. Umbones gently convex with a slightly angular posterior slope that merges into the general convexity of the shell near the postero-basal margin. Shell marked by regular concentric lines of growth, and a few obscure radiating lines on the posterior umbonal slope.

This species most resembles *Macrodon hamiltoniæ*, but is distinguished from that species by being shorter in proportion to its length, subangular posterior umbonal slope, and the absence of radiating lines, except obscure ones on the posterior umbonal slope. The surface ornamentation is a prominent feature in *M. hamiltoniæ* while the lines on this species are quite inconspicuous, though our shells are finely preserved.

Found by R. A. Blair, in the Chouteau limestone, near Sedalia, Missouri, and now in the collection of S. A. Miller.

MACRODON BLAIRI, n. sp.

Plate II, Fig. 19, right valve of a large specimen; Fig. 20, left valve; Fig. 21, left valve of a small specimen; Fig. 22, cardinal view; Fig. 23, left valve of same showing some of the shell at the posterior end; the basal margin is eroded; Fig. 24, left valve of a medium specimen.

Specimens in this species variable in size, from small to large. Shell elongated, about twice as long as high. Highest near the anterior third. Valves convex, thickness about two-thirds the height. Cardinal line straight and constituting the greatest length of the shell. Anterior end angular at the cardinal line and gently recurved to the basal margin like the prow of a boat. Posterior end truncated to near the post-basal margin and then abruptly rounded into the base; sometimes the cardinal line terminates in an acute point and the truncated end is incurved to near the post-basal margin. Basal margin broadly rounded or nearly parallel with the cardinal line in the middle part. Beaks near the anterior third of the shell, somewhat acute and rising above the hinge line. Umbones slightly depressed, with an undefined sulcus near the beaks, which fades out on the convex part of the shell, and does not produce a constriction at the basal margin. Post-umbonal slope subangular and extends to the post-basal margin. Surface marked by concentric, lamellose lines of growth and finer radiating striæ that are plainly visible on the casts, to the unaided eye, but on the shell itself presents a beautiful cancellated ornamentation.

This is a very handsome and marked species that cannot be mistaken for any other.

Found by R. A. Blair and S. A. Miller, in the Chouteau limestone, near Sedalia, Mo., and now in the collection of S. A. Miller. The specific name is in honor of the veteran collector, R. A. Blair.

FAMILY AVICULIDÆ.

POSIDONOMYA LASALLENSIS, n. sp.

Plate I, Fig. 17, left valve; Fig. 18, same magnified two diameters.

Species medium size. Shell subovate. Anterior margin obliquely truncated in front of the beaks, and then vertically, so as to leave a small ear in front, and then broadly rounded, which is continued regularly into the basal margin. Hinge line straight posterior to the beaks, slightly elevated and terminates in an obtuse extremity. Posterior margin below the wing broadly rounded which is continued regularly into the evenly rounded base. The posterior wing is flat, and separated from the body of the shell by an oblique undefined sulcus. Beak anterior to the middle of the shell, acute but not projecting much if any above the hinge margin. Umbones convex, and merging into the general convexity of the shell. Surface marked by six or seven distant, elevated, concentric rounded ridges that do not appear as concentric undulations of growth, but as distinct lines of surface ornamentation. Between these rounded ridges there are numerous fine concentric lines.

This species is so different from all other forms that have been referred to *Posidonomya* that it is with some hesitation we refer it to that genus. It is an aviculoid shell and seems to be nearer to that genus than to any other in the family *Aviculidæ.*

Found in the Coal Measures at La Salle, Illinois, and now in the collection of Wm. F. E. Gurley.

LIOPTERIA SUBOVATA, n. sp.

Plate II, Fig. 7, left valve; part of the ear broken away; Fig. 8, right valve of another specimen; Fig. 9, left valve of another specimen.

Species medium size, subrhomboidal. Body obliquely subovate. Anterior margin nearly straight above and abruptly rounded into the basal margin below. Basal margin narrowly rounded. Posterior margin somewhat straight above and abruptly rounded into the basal margin below. Hinge line straight from the anterior side of the beak to the posterior extremity, and nearly as long as the shell. Beak of each valve obtuse and situated near the anterior side of the shell. It is separated from a short ear by an undefined longitudinal sulcus. Both valves are moderately gibbous, the left valve rather more convex than the right. The posterior umbonal slope is rounded and soon merges into the general convexity of the shell. The wing is flat and terminates in a long acute extremity. The shell is marked with concentric lines of growth.

All of our specimens are casts and the left anterior ear is always injured. No radiating lines are discernable.

This is a shorter form with a larger wing than *L. speciosa*, and its general outline will distinguish it from all other species.

Found by R. A. Blair, in the Chouteau limestone, near Sedalia, Missouri, and now in the collection of S. A. Miller.

LIOPTERIA SPECIOSA, n. sp.

Plate II, Fig. 10, left valve, slightly broken anterior to the beak.

Species rather above medium size, subrhomboidal. Body narrow above and obliquely elongate-ovate. Anterior margin broadly rounded above and abruptly curving into the basal magin below. Posterior margin nearly straight until it rounds into the basal margin. Hinge line straight from the anterior side of the beak to the posterior extremity and about half the length of the shell. Beak of the left valve obtuse and situated near the anterior end of the shell. It is separated from a short ear by an undefined longitudinal sulcus. The umbonal region is somewhat gibbous, but the greater gibbosity of the valve is in the middle part. The posterior umbonal slope is subangular above but gradually fades away below and is lost in the general convexity of the shell. The wing is small, flat and has an acute extremity. Shell marked with distant concentric lines of growth.

All of our specimens are casts of the left valve, no part of the shell is preserved, and no radiating lines are discernable.

This species is distinguished by its oblique, elongate-ovate form and small posterior wing.

Found by Miss Jessie Blair, in the Chouteau limestone, near Sedalia, Missouri, and now in the collection of S. A. Miller.

FAMILY MYTILIDÆ.

MYTILARCA JESSIEÆ, n. sp.

Plate II, Fig. 1, left valve nearly complete; Fig. 2, another left valve with more of the anterior end broken off; Fig. 3, part of another left valve; Fig. 4, anterior end of right valve complete; Fig. 5, anterior end of left valve complete, small specimen; Fig. 6, part of the surface of the shell magnified four diameters.

Our specimens are quite variable, from medium to considerably above medium in size.

Shell oblique, elongate, subelliptical, with venticose valves in middle part, where it is subcylindrical. The diameter through the valves in the middle area, is nearly equal to the distance from the hinge to the basal margin. Posterior end of the shell cuneiform and narrowly rounded. Basal margin of the shell oblique, nearly straight or slightly arcuate. Hinge line about half the length of the shell, slightly arching. Posterior to the end of the hinge, the shell is slightly arcuate until it adruptly curves into the post-basal margin. Beaks obtuse and terminal at the anterior end. Umbones high and abruptly rounded to the hinge line, posterior to which the umbonal slope merges into the cuneate form of the shell. Surface marked by concentric lines of growth. Shell thin.

This species is readily distinquished by its general elongate form from all others. We have numerous fragments of this species but most of them are casts. Part only of the shell is preserved on a few of the fragments.

Found by R. A. Blair, S. A. Miller and Miss Jessie Blair, in whose honor we have proposed the specific name, in the Chouteau limestone, near Sedalia, Missouri, and now in the collection of S. A. Miller.

FAMILY MODIOMORPHIDÆ.

ELYMELLA MISSOURIENSIS, n. sp.

Plate II, Fig. 11, left valve; Sig 12, cardinal view of a cast.

Species medium size. Shell subelliptical, narrower in front. Length twice as great as the height. Cardinal line straight posterior to the beaks, but abruptly dropping in front. Anterior end narrowly rounded. Posterior end broadly rounded. Basal margin rounded more gently at the anterior than at the posterior end. Lunnule deeply impressed. Posterior cardinal slope concave. Valves convex and somewhat gibbous in the umboual region. Beaks at the anterior end rounded and incurved over the cardinal line. Umbones high and broadly rounded. Posterior umbonal slope subangular at first, but the angularity gradually fades away and the umbonal ridge is merged into the general convexity of the shell. Surface marked by fine concentric striæ growth.

There may be some doubt about the reference of this species to *Elymella*, as it is quite distinct from the forms Hall referred to that genus. But we think it resembles *Elymella* more than *Modiomorpha* and it certainly belongs to one of the genera. In fact Hall only regarded *Elymella* as a subgenus of *Modiomorpha* but we prefer to treat them at present as distinct genera.

Found by R. A. Blair in the Chouteau limestone, near Sedalia, Missouri, and now in the collection of S. A. Miller.

CYPRICARDELLA EXIMIA, n. sp.

Plate II, Fig. 25, left valve with posterior end broken off.

Species medium size. Shell subrhomboidal to subtriangular. Length one-half greater than the height. Anterior end abruptly truncated anterior to the beaks and then prolonged at the antero-basal extremity and abruptly rounded into the basal margin. Cardinal line arcuate. Posterior margin obliquely truncated, prolonged at the post basal extremity and rapidly rounded into the basal margin. Basal margin broadly and regularly rounded. Beaks at the anterior end and obtuse. Umbones prominent. Umbasal ridge angular and extending to the post-basal extremity. Valves somewhat flattened below the umbones and bearing an undefined shallow sulcus that becomes obsolete before reaching the basal margin. Post-cardinal slope flattened. Surface of the casts marked by faint concentric lines. We have four specimens belonging to this species, all of them are casts, and each one is broken at some point, but together, they show the entire valves. No part of the shell is preserved, and no muscular scars can be distinguished.

While this species has little resemblance to any other one in this genus, we have little doubt that it is a true *Cypricardella*.

Found by R. A. Blair, in the Chouteau limestone, at Sedalia, Missouri, and now in the collection of S. A. Miller.

FAMILY ORTHONOTIDÆ.

PALÆOSOLEN OCCIDENTALIS, n. sp.

Plate II, Fig. 13, cardinal view; Fig. 14, left valve of same specimen, the posterior part is broken away.

Species quite as large or larger than the type of the genus. Shell solenoid but the true length unknown. From other fragments than the one illustrated it is inferred that it represents only the anterior half and that the length is five times the height, but it may be only four times the height. Shell subcylindrical, basal and cardinal margins subparallel. Anterior end obtusely pointed. Posterior end unknown. Beaks near the anterior end, low, but curved over the cardinal line. Umbones rounded and fade away into the general convexity of the shell. Muscular impression large, round and anterior to the beaks. Ligament evidently external. Pallial line not observed. Hinge teeth, if any, unknown. Surface marked with distant concentric lines of growth which are crossed by a few, distant, radiating lines shown upon the cast. The shell, itself, is not preserved.

This species is readily distinguished from *P. siliquoideus*, the only other known species, by the general outline and surface characters, and yet, we think they are congeneric. The muscular impression is unknown in *P. siliquoideus*, but it must be quite small, while, in this species, it is very large. *P. siliquoideus* shows no evidence of an external hinge ligament, and Hall said that it was, probably, internal; but this species, we think, clearly had an external ligament.

Found by R. A. Blair, in the Chouteau limestone, near Sedalia, Missouri, and now in the collection of S. A. Miller.

FAMILY CYTHERODONTIDÆ.

SCHIZODUS SEDALIENSIS, n. sp.

Plate II, Fig. 15, cardinal view; Fig. 16, right valve.

Species medium or below medium size. Shell subquadrate. Our specimens are casts, and somewhat compressed or only moderately convex. Length somewhat greater than height. Anterior end rounded. Basal margin broadly rounded. Posterior end subtruncate and gradually rounded into the basal margin. Cardinal line straight and prolonged posteriorly which produces the subquadrate outline to the shell. Beaks anterior to the middle of the shell, acute, and rising above the cardinal line where they are slightly incurved. Posterior umbonal slope somewhat angular and fading away toward the lower posterior part of the shell. Anterior umbonal slope rapidly merges into the depressed convexity or cuneiform shape of the shell. Pallial line regularly curves from one muscular scar to the other. Posterior end of the cardinal line subalate. Surface of the casts smooth and outline of the muscular scars not indicated.

This species is readily distinguished from all others, but is probably as nearly related to *S. medinensis* as to any other. But the shell of that species has a subtrigonal outline, while the outline of this species is subquadrate.

Found by R. A. Blair, in the Chouteau limestone, at Sedalia, Missouri, and now in the collection of S. A. Miller.

Remarks—We have found no species among the Lamellibranchs, from the Chouteau Group of Missouri, that occurs in any higher or lower Group of rocks. The genera, however, with the exception of *Blairella*, the new genus above described, are known to range geologically, as follows: *Posidonomya*, from the Upper Silurian to the Coal Measures; *Macrodon*, *Schizodus*, *Lunulicardium* and *Edmondia* from the Devonian to the Coal Measures; *Elymella* and *Sphenotus* from the Devonian to the Chouteau; *Cypricardella* from the Devonian to the Warsaew; *Mytilarca* from the Upper Silurian to the Chouteau. *Liopteria* and *Palæosolen* were, heretofore, known only from Devonian rocks, and their range is now extended to the Cnouteau. *Chænomya* was, heretofore, known only from the St. Louis Group to the Coal Measures and it is now brought down to the Chouteau. Species, heretofore described, from the

Chouteau not referable to either of the above named genera, belong to *Pernopecten*, which ranges from the Chouteau to the Coal Measures, and *Grammysia*, which ranges from the Upper Silurian to the Chouteau.

The position of the Chouteau, at the base of the Subcarboniferous System and above the Devonian, is well established, by its crinoidal fauna; but the Lamellibranchs, as above set forth, furnish additional evidence of its place in the geological column, that cannot be misunderstood by any palæontologist. We have seen fragments, too poor for specific description, from the Chouteau, belonging to four other genera of Lamellibranchs, which further support the conclusion derived from those above described.

CLASS GASTROPODA.

ORDER BRANCHIFERA.

Family PLEUROTOMARIIDÆ.

MURCHISONIA INDIANENSIS, n. sp.

Plate II, Fig. 31, lateral view, part of the shell is preserved and a little of the surface ornamentation; Fig. 32, part of surface magnified.

Species very large. Shell elongated so as to be from one-fourth to one-third higher than wide. Volutions five or six. Only three volutions are preserved, in our specimen, but, at least, two are broken away. The last volution is sharply angular at the peripheral band, those toward the apex obtusely angular. The body whorl is rounded below, and slightly concave, from the suture to the peripheral angle. The concave depression is more strongly marked on the volutions toward the apex, between the suture and the periphery. Umbilicus open. Aperture subquadrate, about as high as wide, notched at the periphery. Suture canaliculate. Surface marked by fine striæ directed gently backward from the suture. No revolving ridges.

This species is readily distinguished by its large size, general form, angular whorls, subquadrate aperture, open umbilicus and surface ornamentation. We do not know of any nearly related species.

Found by Geo. K. Greene in the Knobstone Group, at New Albany, Indiana, and now in the collection of Wm. F. E. Gurley.

FAMILY CYCLONEMIDÆ

HOLOPEA GRANDIS, n. sp.

Plate II, Fig. 33, basal view, showing the form of the mouth and the open umbilicus; Fig. 34, lateral view, one whorl broken off at the apex.

Species very large. Shell about as high as wide. Volutions large, ventricose, and increasing rapidly from the apex. Four volutions, regularly rounded externally. Sutures sharply defined. Umbilicus open. Aperture rounded, subovate, somewhat flattened on the inner side, where it is in contact with the preceding volution. Surface ornamented with larger and smaller revolving striæ, which are crossed by finer oblique lines that cancellate the shell. On the body whorl, the largest revolving ridge is above the periphery, and the lines from the suture are directed obliquely backward to it, and then curve forward from it, and then backward over the lower rounded side of the volution.

This species cannot be classed with *Pleurotomaria*, because there is no notch in the aperture. It is not a *Cyclonema*, because it has an open umbilicus. It agrees with the generic characters ascribed to *Holopea*, and for that reason it is referred to that genus. There is no described species of *Holopea* so much resembling it, that any comparison is necessary.

Found by Geo. K. Greene in the Knobstone Group, ner New Albany, Indiana, and now in the collection of Wm. F. E. Gurley.

CYCLONEMA PULCHELLUM, n. sp.

Plate III, Fig. 6, lateral view of a specimen embeded in rock.

Shell large, elongate, subglobose-conical. Height greater than the width. Volutions six, the apex is broken off from the specimen illustrated. The volutions gradually expand from the apex to the last one, which rapidly enlarges to a very ventricose whorl. No umbilicus. The aperture is embedded in the rock, in our specimen, but it is apparently subcircular. Suture sharply defined not canaliculate. There are three strong revolving carinæ on each whorl, somewhat equally distant from each other and the suture, on the smaller volutions, and without diverging from each other or leaving the suture, they all occur, on the upper part of the ventricose whorl, above the periphery. There are a few smaller revolving carinæ that increase in number and spread over the last ventricose volution. There are numerous finer striæ directed gently backward from the suture that cross the revolving carinæ in sigmoid flexures and crenulate the carinæ so as to beautifully ornament the shell. The crenulations are hardly visible to the naked eye but are very distinct under an ordinary magnifier.

This species so far as disclosed, by our specimen, is a *Cyclonema*, possibly, the aperture may be different from a typical species, but we have no doubt, at present, of the generic reference. It is widely separated, however, by its general form and surface ornamentation from all other described species, and no comparison is necessary to distinguish it.

Found by Geo. K. Greene, in the Knobston Group, near New Albany, Indiana, and now in the collection of Wm. F. E. Gurley.

FAMILY EUOMPHALIDÆ.

STRAPAROLLUS MISSOURIENSIS, n. sp.

Plate II, Fig. 35, a specimen preserving the central whorls; Fig. 36, a large specimen, with central whorls broken.

Shell discoid; below medium size. Spire below the plane of succeeding volutions. Volutions five or six, lying in the same plane, slender and very slowly expanding. Transverse section of a whorl nearly circular, but probably slightly ovate with the narrower end on the inside of the volutions. The inner whorls appear to be round, but a subovate form is assumed as the aperture is approached. Aperture not preserved, in any of our specimens. None of the specimens collected exceed an inch in diameter. The surface is generally smooth, but the better preserved specimens show very fine transverse lines, under an ordinary magnifier.

We have numerous fragments of this species and some of them preserve the shell in excellent condition, with five transverse lines resembling those common on *Spirorbis*. The inner whorls might very readily be mistaken for a *Spirorbis*. It resembles *S. clymenioides*, from the Upper Helderberg Group, more than any other species known to the authors. It is distinguished by the more slender whorls, nearer circular transverse sections and surface ornamentation. It is also a smaller species.

Found by R. A. Blair, in the Chouteau limestone, at Sedalia, Missouri, and now in the collection of S. A. Miller.

FAMILY BELLEROPHONTIDÆ.

BELLEROPHON BLAIRI, n. sp.

Plate III, Fig. 7, dorsal view of a cast; Fig. 8, dorsal view showing the shell below the aperture.

Shell medium size, involuted, subglobose. Volutions expanded very moderately until the aperture is approached, when there is a more marked expansion, and recurved lateral lips. Umbilicus small, outer lip with only a moderate sinus in front and sides expanded, recurved and narrowly rounded. Aperture transverse and subreniform. The volutions are rounded toward the apex, but subangular on the sides of the last whorl. A slender dorsal band appears on the last volution which is somewhat obscure on the cast but well defined on the shell. The surface of the shell is ornamented with numerous fine striæ that arise from the dorsal band and curve gently forward and then backward over the obtusely subangular sides where they become obsolete. These transverse striæ are not visible on the cast.

This species is of the type of *Bellerophon bilobatus* from the Lower Silurian and there are several Silurian and Devonian species that bear a more or less striking resemblance to it. There is no difficulty, however, in distinguishing the species on making a comparison. There is no defined species from the Subcarboniferous rocks with which any comparison is necessary. The general form and surface ornamentation readily distinguishes it among species from rocks of the same geological age.

Found by R. A. Blair, in whose honor we have proposed the specific name, in the Chouteau limestone, near Sedalia, Missouri, and now in the collection of S. A. Miller.

BELLEROPHON SEDALIENSIS, n. sp.

Plate III, Fig. 9, dorsal view of a cast; Fig. 10, lateral view of part of a specimen preserving the shell.

Shell medium size, involute, subglobose. Volutions expanded very moderately until the aperture is approached when there is a marked lateral expansion. Umbilicus open. Outer lip with a moderate sinus and expanded narrowly rounded sides. Aperture transverse and subreniform. The volutions are rounded toward the apex, but subangular on the last whorl. The cast shows a central dorsal band, on the last volution, with a furrow on each side bordered by a sharply angular longitudinal line. The shell of this part of the last whorl is not preserved on any of our specimens. The shell is ornamented with numerous longitudinal, revolving furrows separated by fine angular striæ. These revolving furrows are visible upon many of the fragments of the casts, but much more strongly marked upon the fragments of the shell, wherever it is preserved.

This species is readily distinguished from *B. blairi* by the revolving furrows, and from all other described species by the general form and surface ornamentation. Species of *Bellerophon* have been described from the upper Taconic system and from nearly every recognized group of rocks up to the Upper Coal Measures. About ninety species have been illustrated and those which have been named and not illustrated might as well be struck out of the list, for they cannot be recognized by the definitions alone. There is such a general resemblance in the fossils belonging to this genus, that a common observer having learned one species can tell a *Bellerophon* wherever he sees it.

Found by R. A. Blair, in the Chouteau limestone, near Sedalia, Missouri, and now in the collection of S. A. Miller.

CLASS PTERPODA. CLASS GASTROPODA.

ORDER CONULARIDA, n. ord.

This name is proposed to receive conical and pyramidal, pelagic shells, which may or may not have been contracted toward the mouth, but the texture of which is always horny with lime phosphate. The shells during the lives of the animals were flexible. They are smooth, or longitudinally divided and transversely furrowed. There are no muscular scars on the casts or on the shells. All belong to the palæozoic rocks. We refer to this order the family *Conulariidæ*, and the family *Enchostomidæ* hereinafter described.

Waagen used the word *Conularida* in Palaeontologica Indica, page 175, without defining it, or in any way limiting it, except to say, "they were certainly not pelagic shells," and to include in the order three families, which are widely distinct from each other, viz.: *Conulariidæ*, *Thecidæ* and *Tentaculitidæ*. He did not redescribe the family *Conulariidæ*, or describe any species belonging to it or in any way attempt to throw any light upon it. He had before him shells belonging to the family *Hyolithidæ* or *Thecidæ*, and they were the shells for which he was trying to provide a new Ordinal name, but they cannot be referred to *Conularida* for any reason that he suggested or for any other reason thus far put forth. We use the word *Conularida* for pelagic shells having lime-phosphate and not in the sense in which Waagen used it. It is the natural and proper Ordinal name to include the family *Conulariidæ* and cannot be preoccupied for any other purpose, besides, it has been used by others without defining it, for substantially the same purpose that we now use it. The family *Conulariidæ* does not belong to any living order of animals, and hence the necessity for providing an Ordinal name to receive it. And the same may be said of *Enchostomidæ*.

FAMILY CONULARIIDÆ.

There have been described, from the Palæozoic rocks of North America fifty-nine species of *Conularia*, besides three that have been named, but too poorly defined to be recognized. Among the fifty-nine species is *C. gattingeri*, which was named by Safford, in the Geology of Tennessee, p. 289, and compared with *C. trentonensis*, by saying, that it is larger and about ten inches long, and that it was found by Dr. Gattinger, while digging a cellar for his house, in the trenton limestone, in Nashville, Tennessee. This definition is exceedingly imperfect, but Dr. Gattinger made numerous plaster casts of the specimen and distributed them among the scientific men of the country (one of which was presented to S. A. Miller, by Dr. Gattinger, about twenty years ago), which made the form very generally known, and the remarkable size, if other specimens have been found, has prevented any synonym from being made. The species has been recognized, in all catalogues, and Dr. Gattinger has kindly loaned the original specimen, to S. A. Miller, for examination and description, and we propose to describe it, in order that the form may be better known and the specific name retained. We have an invariable rule to never name a new species without describing and illustrating it; but this is not our species, and as a single figure will cover half a plate, we will content ourselves by writing a description of the specimen.

The shell rapidly expands, is subquadrate in transverse section, but the diameter is greater in one direction than in the other. The sides are concave, in the superior part, which may or may not be the normal condition, because the shell is flexible in this genus. The four angles are deeply furrowed. There is a longitudinal line, in the middle of each side. The shell consists of an inner, black, horny layer and an outer, phosphatic layer. Where the outer layer is decorticated the surface is ornamented by transverse, arching furrows separated by narrow, smooth, elevated lines; but, where the outer layer is preserved, the furrows and ridges are about equal in width, and the ridges become crenulated costæ. The costæ are not regularly arched, but curve rather abruptly across the mesial line and are then directed, in nearly straight lines, inclined about ten degrees, to the furrows, at the angles. There are about forty-five transverse, crenulated costæ in an inch in length. The specimen near the larger end, where best preserved, has a diameter one way of two and two-tenths inches, and the other way of one and nine-tenths inches. It tapers, toward the apex, in a distance of three and six-tenths inches, and in the other of one and two-tenths inches. At the smaller end the specimen is broken off diagonally, and at the larger end an inch and a half in length of one of the wider sides is bent down as if approaching the mouth, but the other sides are continued without being bent and show the continuing enlargement of the shell. The greatest length of any part of the shell, that is preserved, is six inches. These measurements indicate that the specimen, when perfect, exceeded ten inches, in length. The surface ornamentation is altogether different from *C. trentonensis*, and the two species can never be mistaken for each other by any palæontologist.

Species of *Conularia* have been described from Trenton, Hudson River, Niagara, Lower Helderberg, Oriskany, Upper Helderberg, Marcellus Shale, Hamilton, Portage, Chouteau, Kinderhook, Waverly, Burlington, Keokuk, Warsaw and Kaskaskia Groups, and from the Lower and Upper Coal Measures. The range is from the early Trenton to the close of the Upper Coal Measures.

The shells are all pyramidal, and vary, in different species, from square and subquadrate, to octagonal and somewhat rounded. They expand slowly or rapidly in different species, and, so far as known, are contracted near the mouth. The mouth appears to have been very large, and no operculum or other shelly covering has ever been found belonging to it. We have examined more than one hundred specimens of *Conularia*, and have never seen the mouth of a single shell, so that what we have said about the mouth is on the authoriiy of others. No muscular scar has ever been found inside the shell or on a cast, by which the animal was attached to the shell. The four angles of the shell are more or less furrowed, and a mesial line, on each side, is always indicated, and sometimes it amounts to a furrow. The shells are ornamented with transverse lines and furrows and costæ, some of which are smooth, others are crenulated, and all are more or less arched toward the mouth. The texture of the shell is horny, with lime-phosphate. The phosphate is conspicuous, in the outler layer. The phosphatic appearance is more strongly marked in some groups of rocks than in others, which is likewise true concerning the horny texture, which, sometims, as in *C. greenei*, resembles the test of a crustacean.

The genus *Conularia* is so distinct from all others that no other genus has ever been confounded with it. It is the only genus in the family *Conulariidæ*. Any one having ordinary perceptive faculties, after having carefully examined a specimen belonging to any species of *Conularia*, can tell a *Conularia* wherever he sees it, no matter to what species it belongs. This cannot be done with any other fossil specimen from the palæozoic rocks except, possibly, a *Bellerophon* or an *Orthoceras*.

The genus made its appearance, in the Trenton period, represented by small and large species, as fully developed and possessed of as distinctive specific characters, as the genus ever acquired. These it retained, throughout its life history, and closed its career in the Coal Measures, by such large species as *C. roeperi* and such small species as *C. crustula*. It came from some quarter wholly unknown, and after having lived as long as any other genus ever did upon the face of the earth, except, possibly, *Bellerophon*, *Pleurotomaria*, *Murchisonia*, *Orthoceras* and one or two genera of the *Brachiopoda*, it disappeared as abruptly as it came, without leaving a trace of its final course behind it. There is no evidence of development or evolution connected with the genus. It never showed any higher or lower stage of existence, than it did when it first appeared. Some species had a wide geographical and geological range; for example, *C. trentonensis* from New York and Kentucky, and *C. subcarbonaria* from the Keokuk Group, at Crawfordsville, Indiana, and Hamilton, Illinois. We have seen large specimens and small specimens belonging to the same species, possessing exactly the same ornamentation and surface characters. But we have never seen anything that indicated advancement or decline in the genus or in any species, and further, we have never seen any intermediate forms, that might be said to represent a link connecting any two species. This may be cold comfort, to those limited palæo-biologists, who claim to see, in every fossil, a link from the lowest to the highest stages of animal existence. It is, nevertheless, true, that we do not even know to what Class, in the animal kingdom, the family *Conulariidæ*, or the Order, *Conularida* should be referred.

The family *Conulariidæ* has been dumped into the Class *Pteropoda*, by some authors, and into the Class *Gastropoda*, by others, and, probably, the reason has been about as good in the one case as in the other; for it may have no near relation to either. It is like the *Graptolitidæ*, no one knows to what Class it belongs, though every author, having anything to do with the family, will drop it into some Class, and say nothing about the reason for doing so.

It is not scientific to name a Class, in the subkingdom Mollusca, when the definition of the Class and a single order belonging to it must, necessarily, be the same. We have gone as far, in Classification, by briefly defining a new Order, as it is practicable to go, in the present state of the learning, besides, we anticipate future discoveries will throw important light upon the subject. *Conularia* belonged to the great ocean, but whether its home was in the depths or near the surface, we do not know. If it had been a littoral shell, it would not have found a place in so many Groups of rocks, where other littoral shells are unknown. It possessed a hardy shell, capable of preservation in nearly all deposits, or we would not find it, with its peculiar purple, phosphatic lustre, in sandstones, clays, shales, and limestones. We find it scattered here and there, generally very rare, and never in abundance, which indicates that we have not found it in its best and favored habitations. When we find it in abundance, we may find and recognize its relatives, and, even before that time, or at any time, we are liable to see them unearthed, for we have seen only a very small part of the rocks belonging to our country.

CONULARIA ROEPERI, n. sp.

Plate III, Fig. 1, middle part of a specimen, wider side; Fig. 2, transverse section.

Species large, long, slowly expanding, pyramidal, subquadrate, in transverse section. Transverse diameter a little greater between the sides one way than the other. Sides slightly conevx. The four angles deeply furrowed. Longitudinal line in the middle of each of the four sides, but it cannot be called a furrow, as it does not, in all cases, break the transverse costæ. Surface ornamented with transverse arches, shallow, smooth furrows, that are separated by fine lines or costæ. In passing across the sides the costæ curve forward toward the aperture, and sometimes alternate in the middle, and at other times cross the mesial line almost without interruption. The distance between these transverse lines does not seem to increase with the size of the shell, but is uniform throughout the length of our specimen. The lines do not curve forward toward the aperture in the furrows, at the angles, as is usual in this genus, but they arise from the bottom of the furrows and cross the sides in regular arches. There are about fifty of these transverse lines in an arch.

Our specimen has a length of nearly five inches. The transverse diameter at the small end is an inch one way, and an inch and one-twentieth the other, and at the large end an inch and a half one way and an inch and six-tenths the other. It is quite evident if the specimen was complete it would be more than a foot in length.

It is unnecessary to compare it with any other specimen for the purpose of distinguishing it.

Found in the Coal Measures of Luzerne County, Penn., and presented to S. A. Miller by Rev. Wm. Roeper, an ardent collector and naturalist, in whose honor we have proposed the specific name.

CONULARIA GREENEI, n. sp.

Plate III, Fig. 3, middle part of a specimen.

Species long, slowly expanding, pyramidal, subquadrate, sides equal, deeply furrowed at the four angles. Longitudinal line in the middle of each side. Surface ornamented with wide, concave, smooth furrows that arch forward from the four angles. These furrows are separated by sharp costæ generally without crenulations. The costæ sometimes cross the mesial line without interruption, in other cases they terminate alternately at the mesial line. They do not curve forward when bending into the furrows at the four angles, nor do they reach the bottom of the furrows. They alternate in these furrows. The transverse furrows are crossed by a few longitudinal wrinkles, at the margin of the longitudinal furrows.

There are only thirteen transverse furrows in an inch, where our specimen is eight-tenths of an inch in diameter. The shell of our specimen is horny, and has the smooth, hard appearance of the test of a trilobite.

This species is so different from all that have heretofore been described, from the Keokuk Group, that no comparison with any of them is necessary. It is distinguished by its slender form, wide, transverse, smooth furrows and sharp costæ. There are some slight crenulations on the costæ, toward the larger end of our specimens, but none toward the smaller end.

Found by Geo. K. Greene, in whose honor the specific name is given, in the Keokuk Group, at Edwardsville, Indiana, and now in the collection of Wm. F. E. Gurley.

CONULARIA SEDALIENSIS, n. sp.

Plate III, Fig. 4, fragment from the middle part of a specimen, somewhat twisted; Fig. 5, under side of the shell showing the nodes on the costæ.

Species large, rather rapidly tapering, pyramidal, subquadrate, in transverse section. We have several fragments of this species that are twisted and curved in different directions, showing the great flexibility of the shell itself. The specimen illustrated in Fig. 4, presents the largest undisturbed surface of any of them. The sides, as near as can be determined, are flat and equal. The angles are not very deeply furrowed, and the longitudinal line in the middle of each side is not very strongly marked. Surface ornamented with wide, transverse, arching furrows that are separated by coarse costæ. In passing across the sides, the costæ curves forward toward the aperture, and sometimes alternate at the mesial line, and at other times cross it without apparent interruption. The costæ are geniculated at the furrows, at the four angles. The inner layer of the shell is of a light gray color and differs very little in color from the limestone matrix; the second or middle layer is of a reddish brown color and horny texture. The costæ bear a line of strong tubercles which are so fixed in the matrix that the shell is split and decorticated in removing it from the matrix. The tubercles and the middle layer of the shell are broken away from the costæ on the specimen illustrated by Fig. 4, but the second layer is preserved in many of the furrows, where it is perfectly smooth. In some places, on some of the specimens, the tubercules may be seen on the costæ, but they are best shown in the matrix after the shell is taken out, as shown by figure 5. There are thirteen costæ to an inch in length, where a side is one and one-third inches wide, and forty-two tubercles on one of the costæ in an inch in length.

This species is distinguished by its wide transverse furrows, coarse costæ and strong, distant tubercles, without other ornamentation.

Found by R. A. Blair, in the Burlington Group, at Sedalia, Missouri, and now in the collection of S. A. Miller.

ENCHOSTOMA n. gen.

[Ety. *enchos*, sword; *stoma*, blade.]

Shell smooth, elongate, lanceolate, transverse section more or less rounded or narrowly subovate. Shell substance thin, solid, flexible, horny, lime-phosphate. Type *Enchostoma lanceolatum*, described as *Hyolithes lanceolatus*, S. A. Miller, 1892, advance sheets, 18th Rep. Geo. Sur. Ind. p. 63, from the Chouteau limestone.

When the species *Hyolithes lanceolatus* was described, only a few fragments had been selected and the specimen then illustrated was supposed to represent nearly the complete length, but later collections from Sedalia and Providence, Missouri, showed it was not half the length of the original. We have a specimen now before us two inches in length, which is broken off at both ends, and the smaller end is as large as the smaller end of the type, which is less than an inch in length. Another specimen at hand an inch and a quarter in length, is larger at the smaller end than the type is at the larger end. Another fragment an inch in length is no larger at the larger end than the type is at the smaller end. The evidence thus furnished shows that a complete specimen would be three inches in length or even more than that, and that the greater diameter at the larger end, is three-tenths of an inch. We have examined about fifty fragments, none of them seem to be complete at either end, but as none of them seem to contract toward the larger end, we infer that the species does not contract toward the mouth, as in *Conularia*. The smaller end of all our specimens, though in some cases, not exceeding one twenty-fifth of an inch in diameter, is broken off, so that evidently a perfect specimen has an acute point. All of the specimens from the apical end of the shell show a curvature, and the best specimens show a curvature of an eighth or tenth of a circle. The apical end is round in the best preserved specimens, but all of them are subovate toward the mouth. As many of them are compressed toward the larger end it is hard to tell the correct transverse section, but from the large number examined, it is clear that the section illustrated in fig. 36, pl. IX, of the 18th Rep. of the Geo. Sur. Ind., is somewhat compressed. A normal section, probably, becomes more and more acutely ovate as the mouth is approached.

A few fragments on hand are longitudinally fluted, but if they are normal, they belong to a distinct and undescribed species.

The texture of the shell distinguishes this genus from the *Hyolithadæ* and brings it into some kind of relation to *Conularia*. It cannot, however, be fairly classed with the *Conulariidæ* though properly falling within the order *Conularida*. We, therefore, propose the family name *Enchostomidæ*, but the family name as at present understood, will take the same definition that the genus has. We have seen fragments of a long, arching, round shell, somewhat, in form, like a *Dentalium*, in limestone, belonging to the Keokuk Group, but having the shell texture of this genus, that may be generically distinct and if so the family *Enchostomidæ* may be defined and limited so as to include two genera.

The shells in the families *Hyolithidæ* and *Tentaculitidæ* are thick and composed of layers that may sometimes be horny, but they are never phosphatic. There is as much difference in the texture of the shells of *Conularia* or *Enchostoma* and *Hyolithes* or *Tentaculites* as there is between the shells of *Lingula* or *Discina* and *Orthis* or *Spirifera*. And there is as much reason for placing *Conulariidæ* in an Order distinct from *Hyolithidæ* and *Tentaculitidæ* as there is for dividing the *Brachiopoda* into the Orders *Lyopomata* and *Arthropomata*. The fundamental difference in the composition and texture of the shells is the basis of the separation into Orders. The general form of the shells in the genera *Conularia*, *Enchostoma*, *Hyolithes* and *Tentaculites* is altogether different as well as the composition and texture. *Conularia* are pyramidal *Enchostoma* round and curved toward the apex and ovate toward the mouth, *Hyolithes* short, flattened on one side and straight, and *Tentaculites* straight, round and annular.

As a general rule a palæontologist is able to classify the fossils with reference to some known living organism. He finds a trace or path from the unknown animal to the known, and reasons forward from remote ages to the present, and he finds here and there a fauna that characterizes a geological age and enables him to determine it at distant localities, but the *Conularida* at present are to be classified with the unknown, save that they are evidently mollusks and belong to the great Palæozoic ages.

CLASS CEPHALOPODA.

ORDER TETRABRANCHIATA.

FAMILY CYRTOCERATIDÆ.

CYRTOCERAS DUNLEITHENSIS, n. sp.

Plate III, Fig. 11, lateral view, showing a great part of the chamber of habitation; Fig. 12, transverse section.

Shell medium size, strongly curved and regularly enlarging from the apex to the mouth. The siphuncle is on the ventral side or outer margin of the curve and produces an expansion of the shell, which forms, as shown in a transverse section, the narrow end of a sharply ovate figure, at the ventral margin. The sharply ovate transverse section is represented in figure 12. Twelve septa have a length, on the inner curve or dorsal side, of six-tenths of an inch, and, on the ventral side of one and eight-tenths inches, where the dorso-ventral diameter, at the smaller end, is half an inch, and, at the larger end, nine-tenths of an inch. The greatest lateral diameter is about the dorsal third of the shell where it measures, at the same sections, thirty-five hundredths of an inch, at the smaller end, and eighty-five hundredths of an inch, at the larger end. The septa cannot be distinguished near the apical end of our specimen. The chamber of habitation is, probably, nearly complete, in our specimens, and it constitutes more than one-third of the entire length of the shell. Part of the shell is preserved on the inner dorsal side and shows regular lamellose lines of growth, without other ornamentation. Part of the shell is also preserved over the siphuncle and posterior ventral side of the body chamber, which shows the lamellose lines of growth curve backward, in crossing the siphuncle, and indicates a notch or sinus at the ventral lip of the aperture. Where the shell is decorticated, the cast is smooth.

This species is distinguished by its strong curvature, rapid enlargement, sharply ovate transverse section, long body chamber and lamellose lines of growth.

Found in the Trenton Group, at Dunleith, Illinois, and now in the collection of Wm. F. E. Gurley.

FAMILY ORTHOCERATIDÆ.

ORTHOCERAS CALDWELLENSIS, n. sp.

Plate IV, Fig. 1, middle part of a specimen; Fig. 2, transverse section.

Shell straight, large, long, very slowly and regularly enlarging from the apex toward the mouth of the chamber of habitation. Only the middle part of the shell is preserved in our specimens. Chamber of habitation unknown. Transverse section subelliptical. Siphuncle subcentral. The shell is preserved, on our specimen, and the air chambers are not, therefore, exposed. The shell is widely and deeply annulated or transversely furrowed. The dividing ridges are nodose. The nodes are arranged in longitudinal rows. There are fourteen nodes on each transverse ridge, in the specimen, and hence, there are fourteen longitudinal rows of nodes. A longitudinal line crosses each furrow from node to node, but it is nearly obsolete at the bottom of the furrows. The width of a furrow or distance between two nodes, at the larger end is equal to one-third of the shorter diameter of the shell; but, at the smaller end of the specimen, the distance between two nodes is more than one-third of the greater diameter. The width of the annulatinus, therefore, do not bear a regular proportion to the diameter of the shell. There is an obscure node between the regular nodes, at the larger end, but none near the smaller end. The septum shown, at the smaller end, is highly arched, and, it appears as if there is only one septum to correspond with each annulation. The shell is thick, and the outer surface of the furrows shows no lamellose lines of growth, but, possibly, a better preserved specimen would show such lines.

This species has more resemblance to *O. nodocostum*, from the Niagara Group, than to any other described species. *O. nodocostum* is frequently classed as a synonym for *O. annulatum*, but the two species are distinct and are readily distinguished, by any palæontologist, from an examination of the shells or the casts. The annulations are wider and the nodes are not as prominent, in this species as they are in *O. nodocostum*, and the septa are evidently more distant from each other, and more highly arched. *Orthoceras* was a pelagic shell and, probably, lived as long upon the face of the earth as any other genus ever did. The annulated forms made their appearance, in the Lower Silurian age, and are found in all Groups of rocks, from there into the Subcarboniferous. The form called *O. annulatum* occurs, in the Niagara Group, on both sides of the Atlantic, and almost everywhere, that the rocks of that age are known to exist.

Found by James G. Caldwell, in whose honor the specific name is given, in the Upper Helderberg Group, in Clarke County, Indiana, and is now in the collection of Wm. F. E. Gurley.

FAMILY GOMPHOCERATIDÆ.

POTERIOCERAS JERSEYENSE, n. sp.

Plate IV, Fig. 3, side view of a specimen somewhat compressed.

Shell large, acutely obovate or balloon-shaped. Body chamber much longer than the septate portion. Greater diameter about the middle of the body chamber. Section subcircular. Our specimen is somewhat compressed so that a transverse section cannot be accurately determined. The body chamber appears to be bulged on one side. Probably, most tumid on the lower ventral side. Our specimen shows six air chambers and probably there were never more than two or three more. If complete, therefore, there would not be more than eight or nine small air chambers.

When compared with *Poterioceres missouriense* which this species most resembles, it will be observed, that the body chamber is one-half longer, and the septate portion much shorter, in this species, than it is in that one. The inclination of the septa or obliquity toward the tumid side is the same in both species.

Found by the late Wm. McAdams, in the Kinderhook Group, in Jersey county, Illinois, and now in the collection of Wm. F. E. Gurley.

FAMILY GONIATITIDÆ.

No one has described a *Goniatite* from the Lower or Upper Silurian rocks of America. The species described from the earliest rocks is *Goniatites mithrax*, from the Upper Helderberg Group, in Ohio. It is possible that the reference of this species, by the collector, to the Upper Helderberg was erroneous, because rocks of the age of the Hamilton Group, in Ohio, have been frequently referred to the Upper Helderberg, but we think that is not probable, and we have no right to assume such to be the case, without some evidence to support the assumption, and we have none. We only know that many species occur in the Hamilton Group, and this is the only one referred to older rocks. Where are its ancestors or from whence did it come?

It is a very large species, with four or more volutions. The outer one embraces the inner ones and closes the umbilicus. A transverse section of a volution is semi-elliptical, the dorso-ventral and transverse diameter being about as two to one.

"The septa curve gently forward, from the umbilicus for nearly two-thirds of the width of the volution; thence more abruptly backward, forming a broad, low, undefined saddle, to a point nearly three-fourths of the width of the volution, when they again bend forward to the margin of the periphery, leaving a broad, deep lobe, which occupies nearly one-third the width of the volution; and thence turning abruptly backward to near the center of the periphery, and sharply recurring, leave an acute triangular saddle on each of the margins, and a narrow, acute, ventral lobe. The saddle occupying the center of the short, ventro-lateral curve is acute at the summit, having a height one-fourth greater than the width at the base, and curving a little more abruptly on the ventral side. The ventral lobe extends about half the depth of the adjacent air-chamber, and is abruptly narrowed below, the walls being essentially parallel and coincident with those of the siphuncle. The septa are thin in the center, thickened and imbricating at the margins, leaving a deeply marked suture line."

The definition is from Hall's Palaeontology of New York, vol. 5, pt. 2, p. 433, and it will be observed, that it includes all the characters ascribed to the genus. If the large size, involute whorls and complicated chambers do not indicate a fully developed *Goniatite*, we would like to know what later species took on characters belonging to a higher stage of animal development. We know there are some more recent species having more angles in the septa, and others with fewer angles, but the increase or decrease, in the number of these, will hardly be held to indicate a higher or lower stage of the development of the animal; for, if so, we need only to turn our attention to angles in the septa, to rate the species in the grade of its animal existence. If the stage of the involution is the measure of the perfection of the animal, then this species reached the highest grade, for the outer volution embraces all the inner ones, and, we cannot assume the contrary, because no older cephalopod ever embraced the inner whorls, in the outer volution, and closed the umbilicus.

What these facts tend to prove is that, so far as we know, the most ancient specimen belonging to the family *Goniatitidæ* that has ever been found in America was as highly developed as an animal and in the structure of its shell, as any more recent specimen. Prof. Hyatt raises the *Tetrabranchiata* to the grade of a subclass and divides it into the orders, *Nautiloidea* and *Ammonoidea* and refers the family *Goniatitidæ* to the Order *Ammonoidea*. This is probably a good classification, but it does not alter the conclusions to be drawn from the facts we are presenting. His idea, however, that "The *efforts* of the *Orthoceratite* to adapt itself fully to the requirements of a mixed habitat of swimming and crawling gave rise to the *Nautiloidea*, and the *efforts* of the same type to become completely a littoral crawler evolved the *Ammonoidea*," does not meet with any support from the shells that have been discovered belonging to the *Goniatitidæ*. One can imagine that from *Orthoceras* through *Cyrtoceras*, *Gyroceras* and other genera arose the *Nautilidæ*, but there is absolutely no connecting link between the *Orthoceratite* and the *Goniatite* that has ever been discovered, and consequently no mental conception can be introduced to supply the omission. We describe below twelve species, eleven of which are new, and refer them to the genus *Goniatites*. They are from different Groups, in the subcarboniferous system and from the Coal Measures. Some have a closed umbilicus, others an open one, the volutions differ greatly, in form, and there are great variations, in the septa, some reversing the order of the sinnosites, in crossing the volutions; but we are unable to distinguish characters which we can call generic and by so doing separate them into different genera. We think Prof. Hyatt would not refer all the species to the same genus, and we appreciate his learning, but are unable to follow him in his generic subdivisions.

GONIATITES BLAIRI, n. sp.

Plate IV, Fig. 4, side view, part of it covered with the matrix; Fig. 5, portion of the ventral or outer margin.

Shell below medium size, discoid. The sides of the volutions are flattened and inclined toward the ventral or outer margin, which is narrowly rounded or subangular. The umbilicus is open and exposes part of the volutions. Our specimen shows less than one and a half volutions and it would appear that about half of each volution is exposed and that a complete specimen would contain about three volutions. Probably the last volution embraces less of the preceding one than the inner volutions do. The sides of the umbilicus are subangular and the greatest lateral diameter of a volution is near the umbilicus, or adjoining the abrupt descent to the umbilical cavity. The dorso-ventral diameter of a volution is very little more than the greatest lateral diameter. The volutions enlarge, at first, very gradually, but the enlargement is increased, toward the outer part of the last volution. The surface is marked by furrows, that are directed moderately backward, from the angle at the umbilicus, for about half the diameter of the volution, and then more rapidly curve backward to the periphery which is crossed by a rather sharp angle. The furrows are separated by sharp angular ridges. Septa and body chamber unknown.

We think there can be no doubt that this species belongs to *Goniatites*, though none of the septa can be seen. The species is distinguished by its general form, flattened volutions, subangular periphery and transverse curving furrows that form an angle on the ventral margin.

Found by S. A. Miller, in the Chouteau limestone, six miles from Sedalia, Missouri, and now in his collection. The specific name is in honor of R. A. Blair.

GONIATITES PARRISHI, n. sp.

Plate IV, Fig. 6, surface form of a septum; Fig. 7, lateral view; Fig. 8, ventral view.

Shell below medium size, discoid, sublenticular, volutions very rapidly expand. Transverse section of a volution semielleptical. The sides of the volutions are somewhat flattened and inclined toward the ventral margin, which is narrowly rounded. The outer volution embraces the inner ones. The umbilicus is small and discloses no part of the inner volutions. The sides of the umbilicus are abrupt and the greatest transverse diameter of a volution is near the abrupt descent to the umbilical cavity. The dorso-ventral diameter of a volution, in the early growth of the shell, does not exceed the transverse, but the dorso-ventral diameter increases more rapidly than the transverse, with the growth of the shell, and soon becomes one-fourth greater, and, probably in older shells than ours, it may become one-half greater. The external shell is unknown. The air chambers are very short and do not increase, in length, in proportion to the increasing size of the volutions. The septa are closely arranged.

Each septum curves gently from the umbilicus forward and back to near the middle of each lateral side, where it forms an obtuse retral angle and is directed nearly straight forward to the ventro lateral margin, where it makes an abrupt retral bend and is directed backward nearly to a line with the first formed angle, and then again bends forward and makes a forward semicircular curve across the median line of the ventral margin. There are, therefore, five saddles and five lobes, which will be best understood by looking at the illustration. The middle saddle curves forward slightly more than the lateral saddles, but the ventro-lateral saddles extend more than twice as far forward and are obtusely rounded at the anterior ends.

This species is distinguished by the general form of the shell and by the surface form of the septa.

Found by W. J. Parrish, in whose honor the specific name is given, in the Upper Coal Measures, at Kansas City, Missouri, and now in the collection of Wm. F. E. Gurley.

GONIATITES ELKHORNENSIS, n. sp.

Plate IV, Fig. 9, lateral view; Fig. 10, ventral view; Fig. 11, surface form of a septum.

Shell very large, discoid. There are between three and four volutions preserved, in our specimen, and, apparently, an entire individual would have seven or eight volutions, all of which are exposed, in the very wide shallow umbilical cavity or depression. The volutions are rolled, in the same plane, and increase more rapidly, in transverse, than in the dorso-ventral diameter. At first the transverse diameter is not greater than the dorso-ventral, but later, as shown by the ventral view in figure 10, the transverse diameter becomes more than twice as great as the dorso-ventral. The ventral side is slightly convex and the dorsal side correspondingly concave, which allows the volutions to be very closely coiled, without properly overlapping. The inner volutions are beveled, on the lateral sides, from the middle part, leaving a middle angular ridge, which gradually approaches, in the last volutions, the ventral margin, and, at the body chamber, forms an angle, at the ventral margin, from which the beveled edge extends to the next inner volution.

The external shell of our specimen is not preserved. The air chambers are very long, but do not increase, in length, in proportion to the increasing size of the volutions, but, on the contrary, do not seem to increase in length at all. Some of the septa are not distinct toward the end of the last volution, and it is not clear whether or not any part of the body chamber is preserved, but the ventral side indicates that another volution is necessary to complete the shell. The septa are distant. They curve gently backward from the umbilicus and then forward each one crossing the lateral side of a volution in a sigmoid flexure, and are then more abruptly directed backward over about one-third the width ot the ventral margin, where each one is abruptly bent forward and forms a semielliptical arch across the middle of the ventral side. There are, therefore, three convex saddles, the middle one being semi-elliptical, and extending only about half as far forward as the less convex lateral saddles do. This will be better understood by looking at the ventral view and the surface form of a septum as represented in the illustrations.

This species is distinguished by the general form of the shell, manner of enrollment of the volutions, transverse section of a volution and by the saddles and lobes in the septa.

Found by Geo. K. Greene in the Coal Measures, on Elkhorn Creek, in Kentucky, and now in the collection of Wm. F. E. Gurley.

GONIATITES MONTGOMERYENSIS, n. sp.

Plate IV, Fig. 12, lateral view; Fig. 13, ventral view; Fig. 14, surface form of a septum.

Species below medium size, globose, volutions slowly expanding. There are between three and four volutions preserved, in our specimen, and, apparently, an entire shell would have more than six volutions; part of the dorsal margin of each is exposed in the deep funnel-shaped umbilicus. The volutions are rolled in the same plane, and increase much more rapidly in the transverse, than in the dorso-ventral diameter. At first, the transverse diameter is not more than twice as much as the dorso-ventral, but, at the end of our specimen, which is somewhere in the fourth volution, the transverse diameter is three and a half times the dorso-ventral and doubtless the end of the volution of an entire shell has a transverse diameter five or six times as great as the dorso-ventral. The ventral side is broadly convex and the dorsal side correspondingly concave, for the width of the inner volution, and between that and the margin, the outer volution is beveled to the form of the funnel-shaped umbilicus. The lateral side of a volution consists of a sharp denticulated edge. The umbilicus is like a hollow cone or funnel bordered by a sharp denticulated margin.

Six furrows arise, at the margin of the umbilicus, at depressions between the denticulations, and are directed forward at an angle of about forty-five degrees, across one-fourth of the width of the ventral side, and then cross the middle part of the ventral side in a slightly undulating line. These furrows divide a volution into six subequal parts, though the distance between them is not uniform and does not increase regularly with the growth of the shell. They cross the shell without any reference to the septa or chambers. The air chambers are not of equal length, but they do not increase in proportion to the increasing size of the shell. The septa cross the ventral side in transverse waving lines. A septum curves from the umbilicus forward and back in the form of a half circle and then forms a retral subangular bend and again curves forward and back in the form of a half ellipse, and again forms a retral subangular bend and curves forward over the middle part of the ventral side somewhat in the form of a half circle depressed in the middle part so as to make it bifid. There are, therefore, five saddles and as many lobes. Four of the saddles are somewhat evenly convex, the middle one is only about two-thirds as high as those adjoining and is abruptly depressed, in the middle part, so as to make it bifid, and form a short narrow lobe in the middle of the ventral side. The illustrations will, at once, give a better idea of the septa than any definition can give.

This species is quite peculiar and is distinguished by the general form of the shell, by the hollow cone-like umbilicus surrounded by the sharp denticulated margin of the last volution, by the six furrows that cross the ventral side of each volution and by the saddles and lobes in the septa.

Found by the late Wm. McAdams in the Coal Measures of Montgomery county, Illinois, and now in the collection of Wm. F. E. Gurley.

GONIATITES FULTONENSIS, n. sp.

Plate IV, Fig. 15, lateral view; Fig. 16, ventral view; Fig. 17, surface form of a septum.

Species medium size, subglobose, periphery regularly rounded; volutions rather rapidly expanding. Transverse section of a volution semi-elliptical, the transverse diameter being a little more than the dorso-ventral. Number of volutions not known. The last volution embraces all the inner ones. Umbilicus small, open but not disclosing the inner volutions. The sides of the volutions are slightly flattened and inclined toward the regularly rounded periphery. The sides of the umbilicus are abrupt, and the greatest transverse diameter of a volution is near the abrupt descent to the umbilical cavity. The external shell of our specimen is not preserved.

The air chambers are very complicated, of moderate length and do not increase in length with the increasing size of the volutions. The septa are close in some places and distant in others, depending upon the peculiar sinuosities. Within the umbilicus there is an angle in each septum in the overlapping part of each outer volution, from which the septum, in a gentle arch, turns over the margin of the umbilicus, and from an obtuse angle, curves forward and back, turning more than a half circle and extending back to an acute and prolonged point from which it takes a retral course and again curves forward beyond the first semicircular curve, and then back to another prolonged point, where it takes another retral course and again curves forward beyond the second prolonged curve and then back to another acute and prolonged point, in line with the two preceding acute points, where it again takes a retral course and extends forward as far as the second prolonged curve, and instead of arching over the middle of the periphery, abruptly curves back a short distance and then forward and back so as to leave the summit of this saddle bifid, and to form a short narrow lobe in the middle of the ventral side. There are, therefore, seven saddles and seven lobes without including the small narrow lobe in the middle of the ventral side. The three saddles on each side rapidly increase in length from the umbilicus toward the periphery, and the one on the periphery has a length about equal to the middle one on each lateral side. The numerous sinuosities of the septa are best understood by observing the illustrations. When we look at an end view of a volution or at the face of a chamber, we see, not only the seven projecting saddles, the middle one of which is bifid, as above described, but also two short ones on each side at the mouth of the umbilicus, one of which is indicated by the gentle arch which turns over the margin above mentioned, and the other is within the mouth of the umbilicus and forms the inner angle of the truncated horn of the subcrescentiform chamber, and precedes the angle first above mentioned. This inner saddle is not disclosed, in a coiled shell, but the one on the margin of each umbilicus might very well be counted, making nine saddles in a septa. The siphuncle is rather large, and as usual, near the dorsal side

This species will be distinguished by its general form, the great number of sinuosities in the septa, and by the nine exposed saddles in each septum.

Found by John Wolf, in the Coal Measures, in Fulton county, Illinois, and now in the collection of Wm. F. E. Gurley.

GONIATITES KENTUCKIENSIS, S. A. Miller.

Plate V, Fig. 1, lateral view of a large specimen preserving the outer shell.

This species was described and illustrated in North American Geology and Palaeontology, page 439, from the inner whorls of specimens, that did not preserve any of the outer shell. The volutions are unusually numerous in this species, though the number in a mature shell is still unknown. Evidently there are ten or more. In a large shell two or three of the volutions may be seen by looking into the umbilicus, but in the younger specimens the inner volutions are not disclosed. The surface of the shell is covered with numerous, sharp, elevated, revolving lines, separated by wider revolving furrows.

In describing this species originally the other side of the volutions was called the dorsal side of the shell, following the terminology of Meek and most of the early authors; but Owen long since showed that in the living Nautilus, the ventral side of the animal is upon the outside and the dorsal side on the inner side of the volution, and most late authors have made their descriptions of the shells of Cephalopods conform to the position of the animal in the shell of the Nautilus. We have adopted this method, and the reader, in order to make comparison with the description by Meek of coiled Cephalopods in the Geological Survey of Illinois, and by other authors in North American Geology and Palaeontology, and elsewhere, will find it necessary to reverse the words dorsal and ventral as applied to the shells, so that they may apply to the supposed position of the animal when within the shell, as evidenced by the position of the Nautilus.

The specimen here illustrated was found by Geo. K. Greene, at the typical locality, in the St. Louis Group, at Crab Orchard, Kentucky, and is now in the collection of Wm. F. E. Gurley.

GONIATITES LUNATUS, n. sp.

Plate V, Fig. 2, lateral view; Fig. 3, end of a volution and ventral view, showing the surface markings on the shell; Fig. 4, surface form of a septum taken from thinner and smaller specimens; Fig 5, end and ventral view of same.

Species large, globose, volutions rather rapidly enlarging and the periphery becoming more and more broadly rounded with the growth of the shell. Figure 2 is a lateral view of a large specimen, though incomplete. It preserves part of the outer shell and does not expose the septa. Figure 3 is a smaller specimen, showing the outer shell but none of the septa. Figure 4 represents a septum from a still smaller specimen, a ventral view of which is represented by figure 5. Number of volutions not known. A transverse section of a volution is lunate or crescentiform. The last volution embraces all the inner ones and closes the umbilicus. The air chambers are short and some parts of the septa come very close together.

Each septum arises from the umbilicus and makes a broad curve backward beyond the middle of the side, where it makes a sharp retral angle and then curves forward and backward forming more than half an ellipse, and, instead of arching over the middle of the periphery, abruptly curves forward a short distance, and then backward and forward so as to make this lobe bifid, and to form a short narrow saddle in the middle of the ventral side. There are, therefore, five saddles and four lobes, but the middle saddle and two middle lobes are very small. The course of a septum is best understood by looking at the illustration. It will be observed that the courses of the septa, in this species, are the reverse of those in the species above described. That is, to form the first lobes, they are directed backward in this species, and forward in those above described. The bifid saddle is directed forward, in the species above described, and, in this, the curve crossing the middle of the ventral side is directed backward, and we have a small central saddle instead of a small central lobe, etc. The surface of the shell is marked by fine, transverse, imbricating lines of growth.

This species is distinguished by its general form, transverse lunate section of the volutions, fine transverse lines of surface ornamentation, and peculiar sinuosities of the septa.

Found by Geo. K. Greene in the Coal Measures, on Elkhorn Creek, in Kentucky, and now in the collection of Wm. F. E. Gurley.

GONIATITES ILLINOISENSIS, n. sp.

Plate V, Fig. 6, lateral view; Fig. 7, ventral view; Fig. 8, surface form of a septum.

Species medium size, subglobose, volutions moderately enlarging' and periphery broadly rounded. Our specimen exposes part of three volutions, leaving the impression that a complete shell contains not less than six volutions. A transverse section of a volution is subcrescentiform, the horns being short and obtuse. The last volution encloses all the inner ones, but leaves a rather large open umbilicus. The air chambers are short and complicated. The outer shell is not preserved in our specimen.

Each septum may be seen to curve backward across the obtuse end of the horn of the crescent, within the cavity of the umbilicus, and form an acute angle at the mouth of the umbilicus, where it curves forward and then backward, in a waving line, to an acute point, which is posterior to the first angle, where it makes a sharp retral angle and curves forward, in a waving line, anterior to the first forward curve or saddle and then backward, in a waving line, to an acute point, which is slightly anterior to the second one, where it makes another sharp retral angle and again curves forward ,in a waving line, to a level with the anterior part of the first saddle, and then abruptly curves back a short distance and then forward and back, so as to make the summit of this saddle bifid and to form a short, narrow lobe at the periphery, in the middle of the ventral side. There are, therefore, two saddles upon each side of the volution, and a bifid saddle in the middle of the ventral part, and one on each side of it, the latter being the longer ones. The two saddles, on the sides of the ventral margin, extend somewhat anterior to the others. The sinuosities of the septa are best understood by looking at the illustrations, and the use of the words "saddles and lobes," for the purpose of reaching a correct understanding, are of doubtful utility.

This species is distinguished by its general form, transverse section of the volutions and the peculiar sinuosities of the septa.

Found by the late Wm. McAdams in the Coal Measures in Montgomery county, Illinois, and now in the collection of Wm. F. E. Gurley.

GONIATITES KANSASENSIS, n. sp.

Plate V, *Fig. 9, lateral view; Fig. 10, surface form of a septum; Fig. 11, ventral view.*

Species medium size, subglobose, volutions very slowly enlarging, and lateral and ventral sides regularly rounded. The number of volutions not known. Transverse sections of a volution concavo-convex and the transverse diameter where our shell is broken off is about three times the dorso-ventral. The transverse diameter diminishes towards the apex more than the dorso-ventral and no doubt increases the proportion toward the body chamber of a mature shell. The last volution encloses all the inner ones and leaves a large open umbilicus. The shell is regularly rounded from the open umbilicus, leaving no distinct lateral sides, and the greater transverse diameter near the abrupt walls of the umbilicus. The air chambers are short and complicated. The outer shell is not preserved in our specimen.

Each septum is broadly arched forward from the umbilicus and then curved backward in a waving line to an acute point, posterior to the commencement at the umbilicus, where it makes a sharp retral angle and curves forward in a waiving line slightly anterior to the first forward curve or saddle and then backward in a waiving line to an acute point, which is slightly anterior to the first acute point, where it makes another sharp retral angle and again curves forward in a waving line to a level with the anterior part of the first saddle and then abruptly curves back a short distance and then forward and back, so as to make the summit of the saddle bifid, and to form a short, narrow lobe at the periphery in the middle of the ventral side. There are, therefore, two saddles upon each side of the bifid saddle, as the periphery of the volution. It will be noticed that the septum above described is very much like the septa in *G. illinoisensis*, and distinguished by having shorter saddles, which are less constricted in the middle part. The sinuosities and shape of the septa in the two species will be best understood by comparing the illustrations.

This species will be distinguished from *G. illinoisensis* by the proportionately large umbilicus, shorter dorso-ventral diameter, less gibbous volutions, which are more abruptly rounded from the umbilicus, and by the form of the septa. It is probably more nearly related to that species than to any other which has been described.

Found by W. J. Parrish in the Upper Coal Measures at Kansas City, Missouri, and now in the collection of Wm. F. E. Gurley.

GONIATITES GREENCASTLENSIS, n. sp.

Plate V, Fig. 12, lateral view; Fig, 13, ventral view; Fig. 14, surface form of a septum.

Species medium size, globose, volutions expanding laterally quite rapidly and broadly rounded from umbilicus to umbilicus. The number of volutions not known. Transverse section of a volution concavo-convex and the transverse diameter, where our shell is broken off, is more than four times as much as the dorso-ventral. The transverse diameter proportionately diminishes toward the apex and increases toward the body chamber. The last volution embraces all the inner ones and leaves a large open umbilicus that is like a hollow cone and formed by the beveling of each outer volution from the inner volution to the margin of the umbilicus. The shell on the interior of the umbilicus is concentrically lined and furrowed. The shell is depressed convex from the margin of one umbilicus to the margin of the other, leaving no lateral sides and the greatest transverse diameter at the margin of the umbilicus. The surface of the shell is finely cancellated. The air chambers are rather long.

Each septum is arched backward from the umbilicus to a rather acute point where it makes a retral angle and curves forward and back in the form of half an ellipse (but not extending quite as far anterior as the point of commencement at the umbilicus) and terminates in an acute point at the middle of the ventral side of the volution. There are, therefore, two complete saddles and a half saddle on each margin of each volution and three intervening lobes. The pecular shape of the septa will be most appreciated by looking at the illustrations.

This species is distinquished by its general form, open concentrically lined umbilicus, flattened volutions, surface ornamentation, and by the form of the septa.

Found in the St. Louis Group at Greencastle, Indiana, and now in the collection of Wm. F. E. Gurley.

GONIATITES SUBCAVUS, n. sp.

Plate V, Fig. 15, lateral view; Fig. 16, end of a volution and ventral view; Fig. 17, surface form of a septum.

Species rather below medium size, subglobose, volutions slowly expanding and broadly rounded from umbilicus to umbilicus. Transverse section of a volution concavo-convex, and the transverse section, where our shell is broken off, is three times as much as the dorso ventral. The transverse diameter proportionally diminishes toward the apex and increases toward the body chamber. The number of volutions not known. The last volution embraces all the inner ones and leaves a large open umbilicus that is like a hollow cone and formed by the leveling of each outer volution, from the inner volution, to the margin of the umbilicus. The shell on the interior of the umbilicus is smooth. The shell is broadly rounded from one umbilicus to the margin of the other leaving no lateral sides and the greatest transverse diameter at the margins of the umbilici. The outer surface of the shell is smooth. The air chambers are very short. Four furrows arise outside of the margin of the umbilicus and curve forward across the ventral side. These furrows do not interfere with the margin of the umbilicus, they are smooth and exist on the outer surface of the shell and on the cast. They do not regularly occur on a volution and belong rather to the outer shell itself than to the body of the volution. It does not appear that they could have had any effect upon the animal.

Each septum arises from the umbilicus and makes a broad curve backward where it turns an obtuse angle and then curves forward nearly as far anterior as the point of commencement and then backward forming more than half an ellipse and again turns an obtuse angle and passes slightly forward to the median line on the ventral side. This forms a bifid lobe and a short narrow saddle in the middle of the ventral side. There are, therefore, five saddles, and four lobes, but the middle saddle and two middle lobes are produced by a bifid lobe.

The septa in this species are very much like the septa in *G. lunatus*, and the open umbilicus is very much like that in *G. greencastlensis*, but the species do not agree in any other respects, and on the whole, have little resemblance to each other. The reader must notice that in looking at figures 5 and 16 he is looking, on the ventral side of the shell toward the apex, and in all other ventral views he is looking toward the anterior end of the shell, and, therefore, the septa in figures 5 and 16 are wrong side up, and the saddles are on the lower side of the septa. Figures 4 and 17 are correct.

Found by the late Wm. McAdams, in the Coal Measures, in Montgomery county, Illinois, and now in the collection of Wm. F. E. Gurley.

GONIATITES JESSIEÆ, n. sp.

Plate V, Fig. 18, lateral view of a small specimen; Fig. 19, end view of a volution and part of a ventral view; Fig. 20, surface view of a septum.

Species medium or above medium size, discoid, sublenticular, volutions rapidly expand, and periphery sharply rounded. We have a specimen more than twice as large as the one that is illustrated, but it shows none of the septa. Transverse section of a volution crescentiform. The sides of the volutions are broadly rounded and the ventral margin more narrowly rounded. The outer volution embraces all the inner ones and closes the umbilicus. The dorso-ventral diameter including the horns of the crescent is about one-half more than the greatest transverse diameter, but the dorso-ventral diameter increases rather more rapidly than the transverse. The external shell is unknown. The air chambers are of medium length.

Each septum curves gently from the umbilicus forward and back, to a point posterior to the place of beginning and near the ventro-lateral margin, where it makes a narrow retral bend and curves forward and backward forming half an ellipse, and then makes a retral bend across the periphery of the ventral side. It is not clear from our specimen whether or not there is a small lobe at the median line. There are, therefore, four saddles and three lobes in each septa as shown by the illustration.

This species is distinguished by its general form, closed umbilicus and surface form of the septa.

Found by R. A. Blair and his accomplished daughter, in whose honor we have proposed the specific name, in the Couteau limestone, near Sedalia, Missouri, and now in the collection of S. A. Miller.

SUBKINGDOM PROTOZOA.

CLASS PORIFERA.

FAMILY RECEPTACULITIDÆ.

RECEPTACULITES DIXONENSIS, n. sp.

Plate V, Fig. 21, basal view; Fig. 22, side view.

Species medium size, general form obovate. Our specimen is more ventricose on one lower lateral side than upon the other. It is a dolomite and the external integument or ectorhim of Billings is not preserved and the internal coating or endorhim is not visible. The part which is presented to us for description is the outer surface of the spicular skeleton.

The base is broadly rounded and has a subcentral, hard, slightly projecting nucleus from which the sigmoidal rows of rhomboidal depressions arise, and curving, at first, gently to the right and to the left, like the engine turnings on a watch, and then curving upward more rapidly, they make more than one revolution around the skeleton before reaching the edge of the summit aperture. All of the rows originate at the margin of the nucleus, and, as they diverge, they increase in diameter, and then contract toward the summit aperture, abruptly stop without the intercalation of any rows. In other words, the surface is covered with the expansion of the rows of rhomboidal depressions that arise at the small solid nucleus, at the base, some of which do not extend to the summit. Each rhomboidal depressions has, within the elevated marginal lines, a transverse furrow with a central pore and one at each end of the furrow. The transverse furrow is crossed by a less conspicuous longitudinal furrow. The central pore is larger than the pore at either end of the transverse furrow. The pores and furrows, probably, represent the spicules which formed the skeleton but have been destroyed. The aperture, at the summit, is subcentral but not well preserved in our specimen.

In 1861, Prof. James Hall, in a pamphlet report on the Geological Survey of Wisconsin, page 16, described without illustration a fossil under the name of "*Receptaculites globulare*," as follows:

"Body globuse or subglobuse, with an irregular base of attachment; transverse diameter usually greater than the vertical diameter; summit a little depressed; cells arranged in radiating curved lines, the apertures rhomboidal and transversely elongated; concentric groove and raised ridges between strongly marked. This species is readily distinguished by its small globose form, which is usually not more than three-fourths of an inch in diameter. It is more rare than either of the others (*R. oweni* and *R. iowensis*) though I am informed by Prof. Daniels, that more than twenty specimens were obtained at a single locality in Wisconsin. About twenty years since, I received a specimen of this species from Mr. Thorp, of Mount Morris, Illinois, and have seen others in Galena, and in the collection of Prof. Daniels. Geological formation and locality.—In the Galena limestone of the lead region of Wisconsin, Iowa and Illinois."

The name and definition might have passed into oblivion, because no one could have recognized the species, if Prof. Meek had not revived it, in the Geological Survey of Illinois, vol. 3, p. 301, pl. 2, fig. 2*a*, *b*. Prof. Meek described under the name of *Receptaculites globularis*, Hall, a species as follows:

"Body obovate, or subglobose, rounded and slightly umbilicated above, and tapering to a rather broad base of attachment below. Cells arranged in the usual regularly curved lines, with transversely elongated rhomboidal apertures, which become exceedingly narrow and crowded on the sides; transverse ridges between the cells and the intervening grooves well defined, and becoming, like the cells, very closely compacted together on the sides. This is probably the form described by Prof. Hall, under the above name, though it is proportionally longer than the specimens upon which the species was founded, which are said to be usually wider than long. We have others, however, from the same locality agreeing more nearly with his description, and apparently not separable specifically from this. Locality and position.—Scales' Mound, Illinois; from the Galena division of the Lower Silurian series."

We have never seen a specimen that resembles the definition given by Prof. Hall, making due allowance for the fact that he called the summit the base; which was an excusable mistake, until after the study of Billings, on Receptaculites, published in 1865, in Palæozoic Fossils, p. 378. But the species illustrated by Prof. Meek will stand for that of Hall, and we come now to compare it with the species herein described. First, however, we must call attention to the fact that Meek also mistook the base for the summit, and his definition must be corrected in that respect, and his figure 2*a* must be regarded as the base instead of the summit, and figure 2*b* must be reversed end for end. The fact too, that our specimen is much larger than any that either Prof. Hall or Prof. Meek mentioned, is immaterial.

Our specimen is convex at the base, and not umbilicated or concave as *R. globularis* is described. Our specimen does not possess the transversely elongated rhomboidal apertures found in *R. globularis.* And the rows of rhomboidal depressions, in *R. globularis*, as shown in the illustration 2*b*, do not pass half way around the skeleton, while in our species they pass around the skeleton and nearly half around again. The two species, therefore, seem to be widely separated from each other, though they occur in rocks of the same geological age.

It may be proper here to remark, that some European authors widely class American fossils in lists of synonyms with European fossils and with fossils belonging to different geological formations, in America. As an illustration, we find *R. globularis*, which is known only from the Galena Group, in the Lower Silurian, and *R. ohioensis*, and *R. subturbinatus* which are known only from the highest members of the Niagara Group, classed by one of those authors as synonyms for *Ischadites koenigi.* It would seem that some of them have no idea of the order of the geological formations in America, and are equally as obscure in making comparisons of fossils. No species of fossils, animal or vegetable, was ever found common to the Galena and Niagara Groups, and there does not seem to have been any excuse for confounding *R. globularis* with *R. ohioensis* of Meek, or *R. subturbinatus* of Hall, on any palæontological grounds or even upon fanciful resemplance. Neither is there anything in the descriptions or illustrations of *R. ohioensis* by Meek, and *R. subturbinatus* by Hall, that would indicate that they might be synonyms. It will be noticed that Meek, in Ohio Palæntology, Vol. 2, and Hall. in the 11th Report of the Geological Survey of Indiana, continue to call the base, the summit of

PLATE I.

Page.

Lunulicardium grande, n. sp. 5

Fig. 1. Right valve.
Fig. 2. Left valve of another specimen.
Fig. 3. Anterior view of same.

Blairella sedaliensis, n. sp. 7

Fig. 4. View of hinge line.
Fig. 5. Outside of the same shell.
Fig. 6. Right valve of a cast.
Fig. 7. Right valve of another cast.
Fig. 8. Cardinal view of the same specimen.

Edmundia albersi, n. sp 8

Fig. 9. Right valve.
Fig. 10. Left valve of another specimen.
Fig. 11. Cardinal view of same.

Chænomya longa, n. sp. 8

Fig. 12. Cardinal view.
Fig. 13. View of left valve.

Macrodon facetus, n. sp. 10

Fig. 14. Cardinal view.
Fig. 15. Right valve.
Fig. 16. Surface of the cast, magnified six diameters.

Posidonomya lasallensis, n. sp 12

Fig. 17. Left valve.
Fig. 18. Same magnified two diameters.

ILL. STATE MUS. OF NAT. HIST.

Bulletin No. 11. **Plate I.**

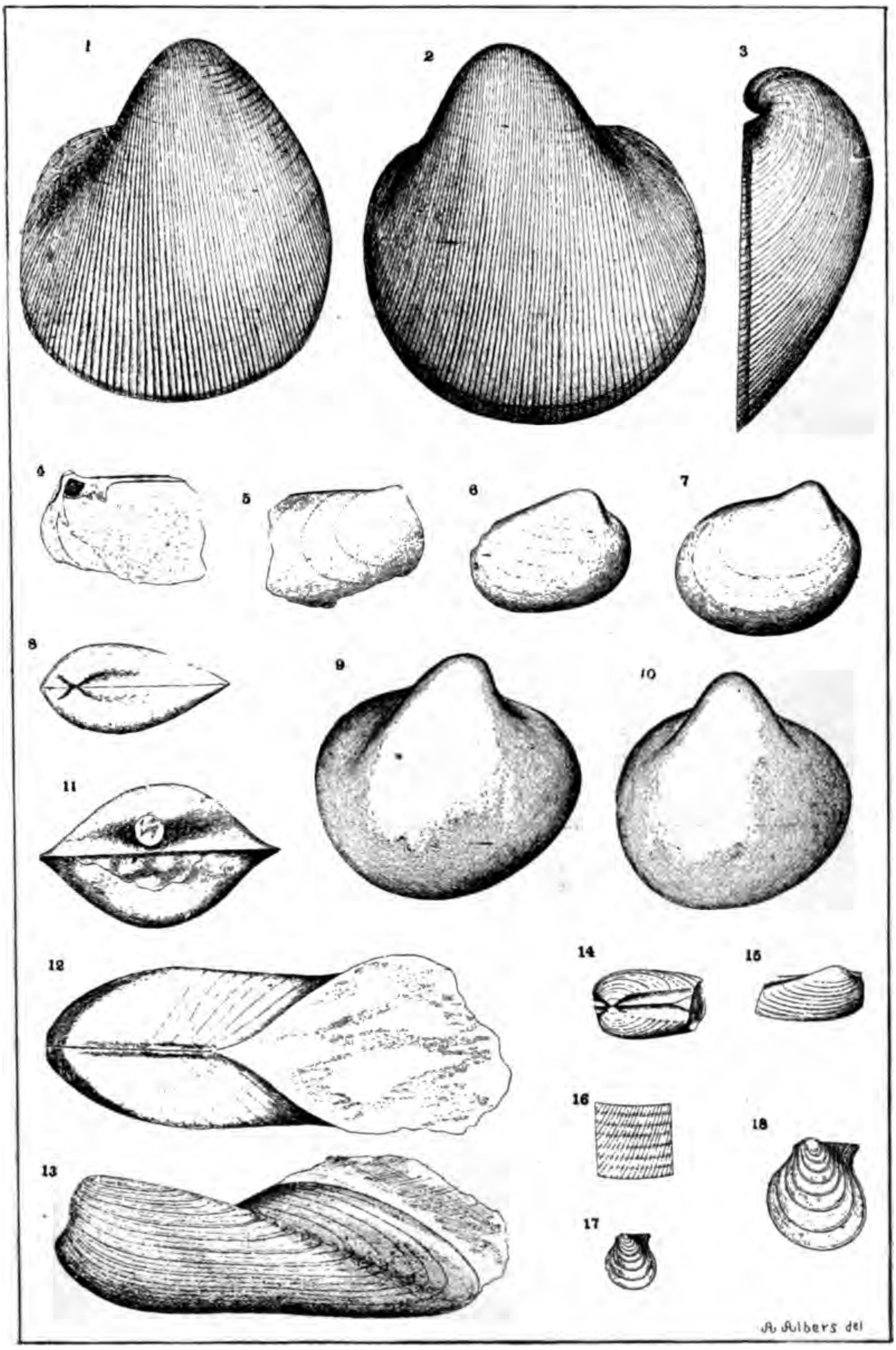

PLATE II.

PAGE

MYTILARCA JESSIEÆ, n. sp. 14
- Fig. 1. Left valve.
- Fig. 2. Left valve of another specimen.
- Fig. 3. Part of another left valve.
- Fig. 4. Anterior cast of right valve.
- Fig. 5. Anterior end of left valve.
- Fig. 6. Part of surface of shell magnified four diameters.

LIOPTERIA SUBOVATA, n. sp. 15
- Fig. 7. Left valve.
- Fig. 8. Right valve of another specimen.
- Fig. 9. Left valve of another specimen.

LIOPTERIA SPECIOSA, n. sp. 15
- Fig. 10. Left valve.

ELYMELLA MISSOURIENSIS, n. sp. 15
- Fig. 11. Left valve.
- Fig. 12. Cardinal view of a cast.

PALÆOSOLEN OCCIDENTALIS, n. sp. 16
- Fig. 13. Cardinal view.
- Fig. 14. View of left valve.

SCHIZODUS SEDALIENSIS, n. sp. 17
- Fig. 15. Cardinal view.
- Fig. 16. View of right valve.

MACRODON PETTISENSIS, n. sp. 10
- Fig. 17. Right valve.
- Fig. 18. Right valve of a larger specimen.

MACRODON BLAIRI, n. sp. 11
- Fig. 19. Right valve.
- Fig. 20. Left valve.
- Fig. 21. Left valve of a small specimen.
- Fig. 22. Cardinal view.
- Fig. 23. Left valve of same.
- Fig. 24. Left valve of a medium sized specimen.

CYPRICARDELLA EXIMIA, n. sp. 15
- Fig. 25. Left valve.

LUNULICARDIUM RETRORSUM, n. sp. 6
- Fig. 26. Right valve.
- Fig. 27. Left valve of a smaller specimen.
- Fig. 28. Cardinal view of same.

SPHENOTUS SINUATUS, n. sp. 9
- Fig. 29. Right valve.
- Fig. 30. Left valve of a smaller specimen.

MURCHISONIA INDIANENSIS, n. sp. 18
- Fig. 31. Lateral view.
- Fig. 32. Part of surface magnified.

HOLOPEA GRANDIS, n. sp. 19
- Fig. 33. Basal view.
- Fig. 34. Lateral view.

STRAPAROLLUS MISSOURIENSIS, n. sp. 20
- Fig. 35. View of a nearly entire specimen.
- Fig. 36. View of a larger specimen.

Plate II.

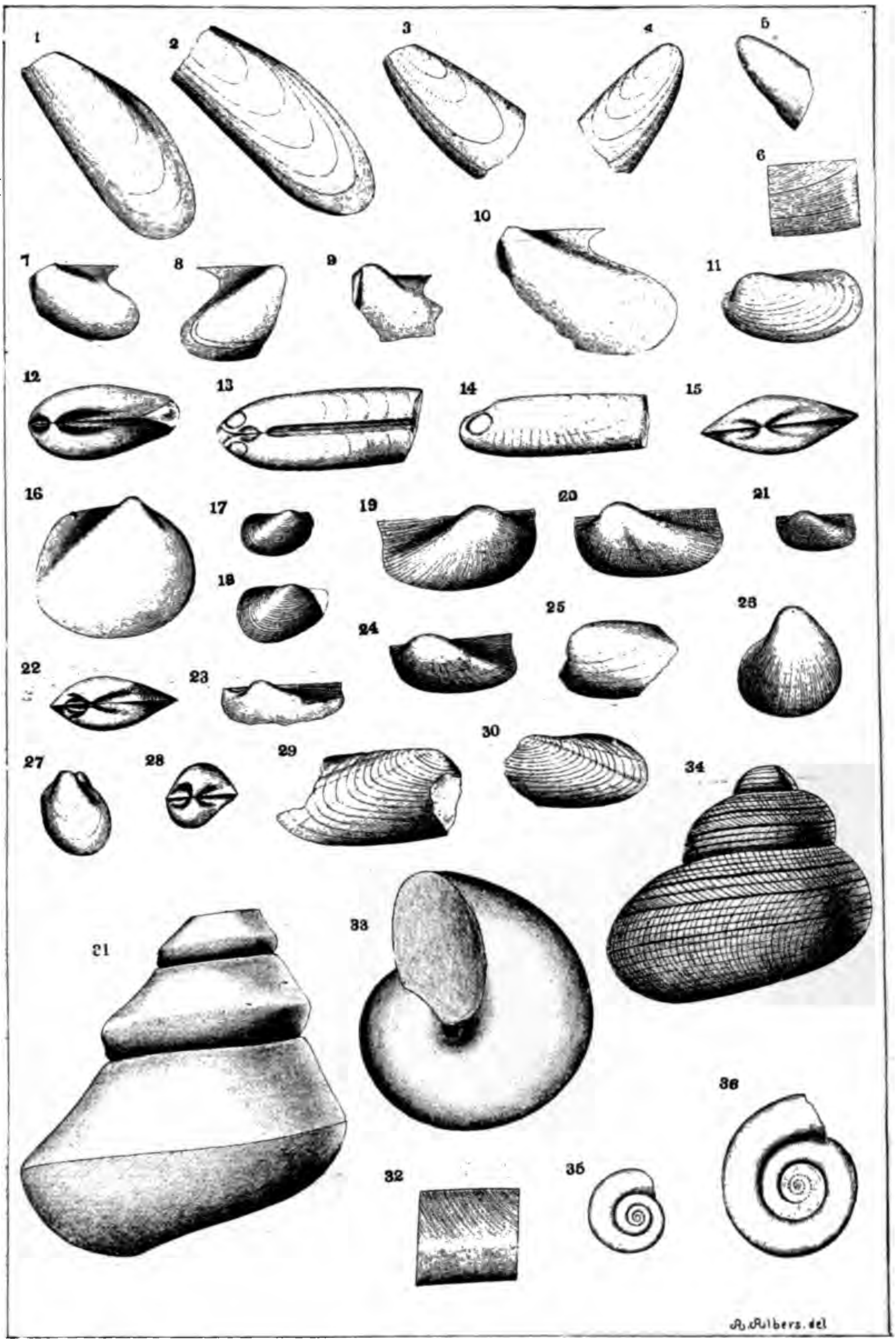
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PLATE III.

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Conularia roeperi, n. sp. 26

Fig. 1. Middle part of a specimen.
Fig. 2. Transverse section.

Conularia greenei, n. sp. 27

Fig. 3. Middle part of a specimen.

Conularia sedaliensis, n. sp. 28

Fig. 4. View of fragment from middle part of a specimen.
Fig. 5. View showing ornamentation on under side of a shell.

Cyclonema pulchellum, n. sp. 19

Fig. 6. Lateral view.

Bellerophon blairi, n. sp. 21

Fig. 7. Dorsal view.
Fig. 8. Dorsal view showing shell below.

Bellerophon sedaliensis, n. sp. 21

Fig. 9. Dorsal view of a cast.
Fig. 10. Lateral view of a specimen showing the shell.

Cyrtoceras dunleithensis, n. sp. 30

Fig. 11. Lateral view.
Fig. 12. Transverse view.

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Bulletin No. 11. **Plate III.**

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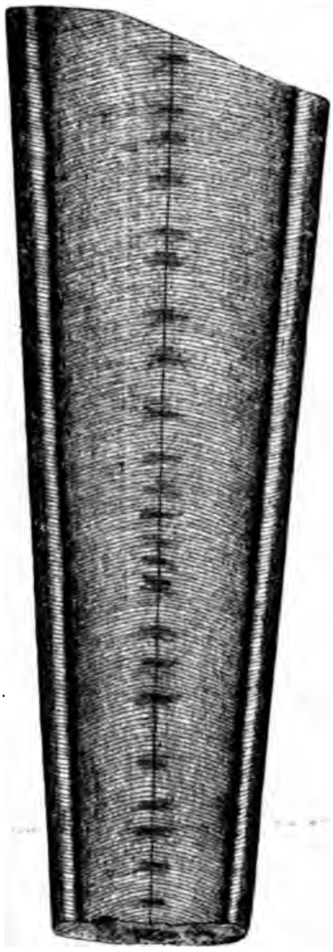

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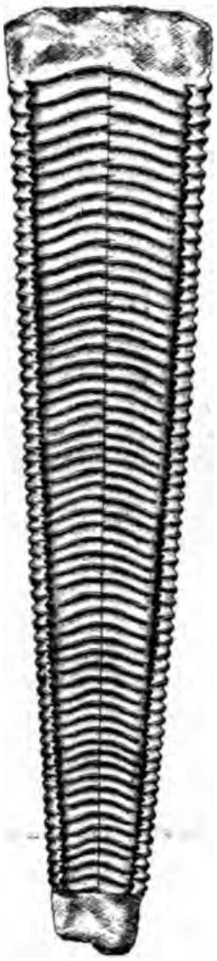

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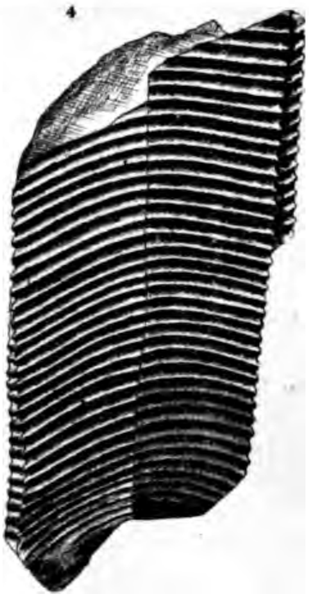

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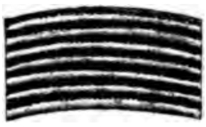

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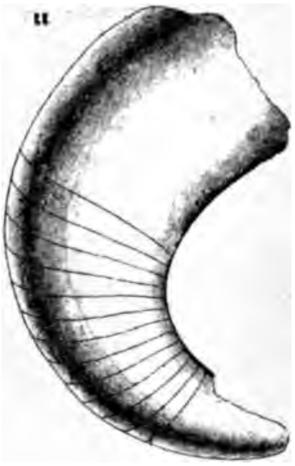

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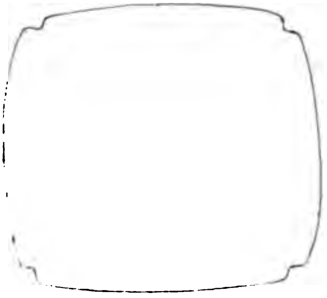

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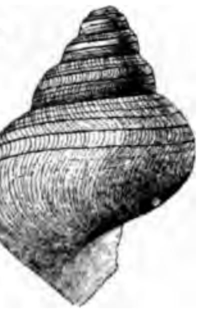

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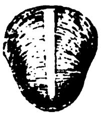

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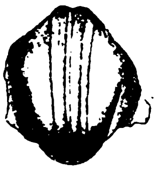

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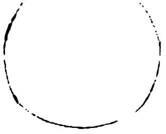

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PLATE IV.

Page.

Orthoceras caldwellensis, n. sp. 31

Fig. 1. Lateral view.
Fig. 2. Transverse view.

Poterioceras jerseyensis, n. sp. 32

Fig. 3. Lateral view.

Goniatites blairi, n. sp. 35

Fig. 4. Lateral view.
Fig. 5. Part of outer margin.

Goniatites parrishi, n. sp. 26

Fig. 6. View of a septum.
Fig. 7. Lateral view.
Fig. 8. Ventral view.

Goniatites elkhornensis, n. sp. 37

Fig. 9. Lateral view.
Fig. 10. Ventral view.
Fig. 11. View of a septum.

Goniatites montgomeryensis, n. sp. 38

Fig. 12. Lateral view.
Fig. 13. Ventral view.
Fig. 14. View of a septum.

Goniatites fultonensis, n. sp. 39

Fig. 15. Lateral view.
Fig. 16. Ventral view.
Fig. 17. View of a septum.

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Bulletin No. 11. **Plate IV.**

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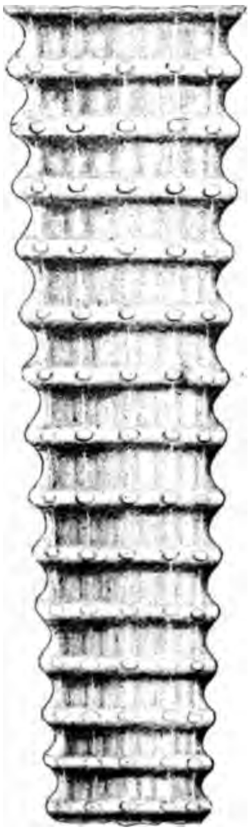

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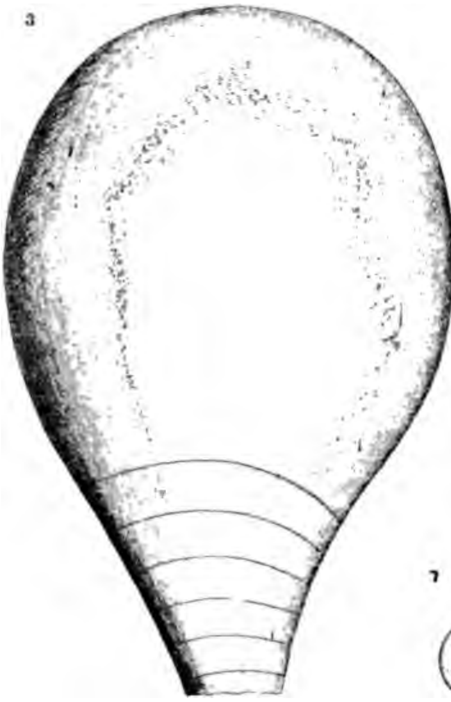

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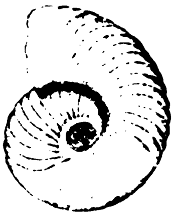

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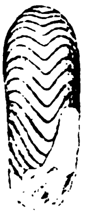

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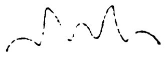

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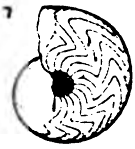

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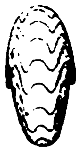

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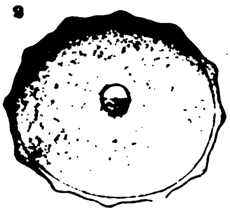

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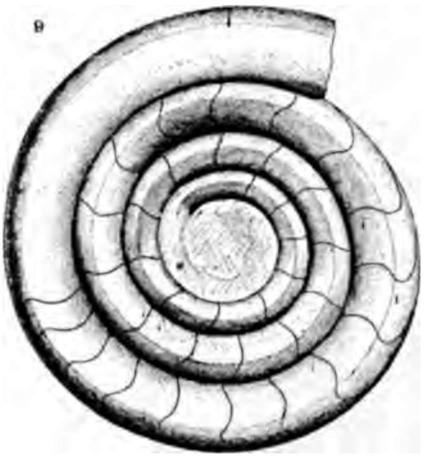

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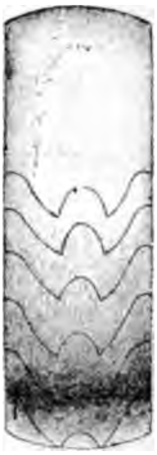

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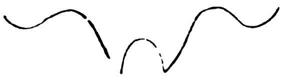

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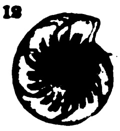

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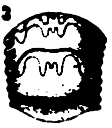

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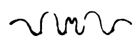

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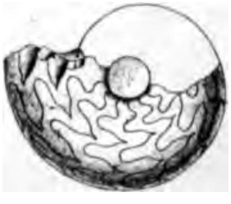

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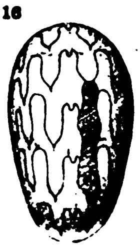

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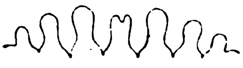

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PLATE V.

Page.

Goniatites kentuckiensis, n. sp. 40

Fig. 1. Lateral view.

Goniatites lunatus, n. sp. 41

Fig. 2. Lateral view.
Fig. 3. Ventral view.
Fig. 4. View of a septum.
Fig. 5. Ventral view.

Goniatites illinoisensis, n. sp. 42

Fig. 6. Lateral view.
Fig. 7. Ventral view.
Fig. 8. View of a septum.

Goniatites kansasensis, n. sp. 43

Fig. 9. Lateral view.
Fig. 10. View of a septum.
Fig. 11. Ventral view.

Goniatites greencastlensis, n. sp. 44

Fig. 12. Lateral view.
Fig. 13. Ventral view.
Fig. 14. View of a septum.

Goniatites subcavus, n sp. 45

Fig. 15. Lateral view.
Fig. 16. Ventral view.
Fig. 17. View of a septum.

Goniatites jessieæ, n. sp. 46

Fig. 18. Lateral view.
Fig. 19. Ventral view.
Fig. 20. View of a septum.

Receptaculites dixonensis, n sp. 47

Fig. 21. Basal view.
Fig. 22. Lateral view.

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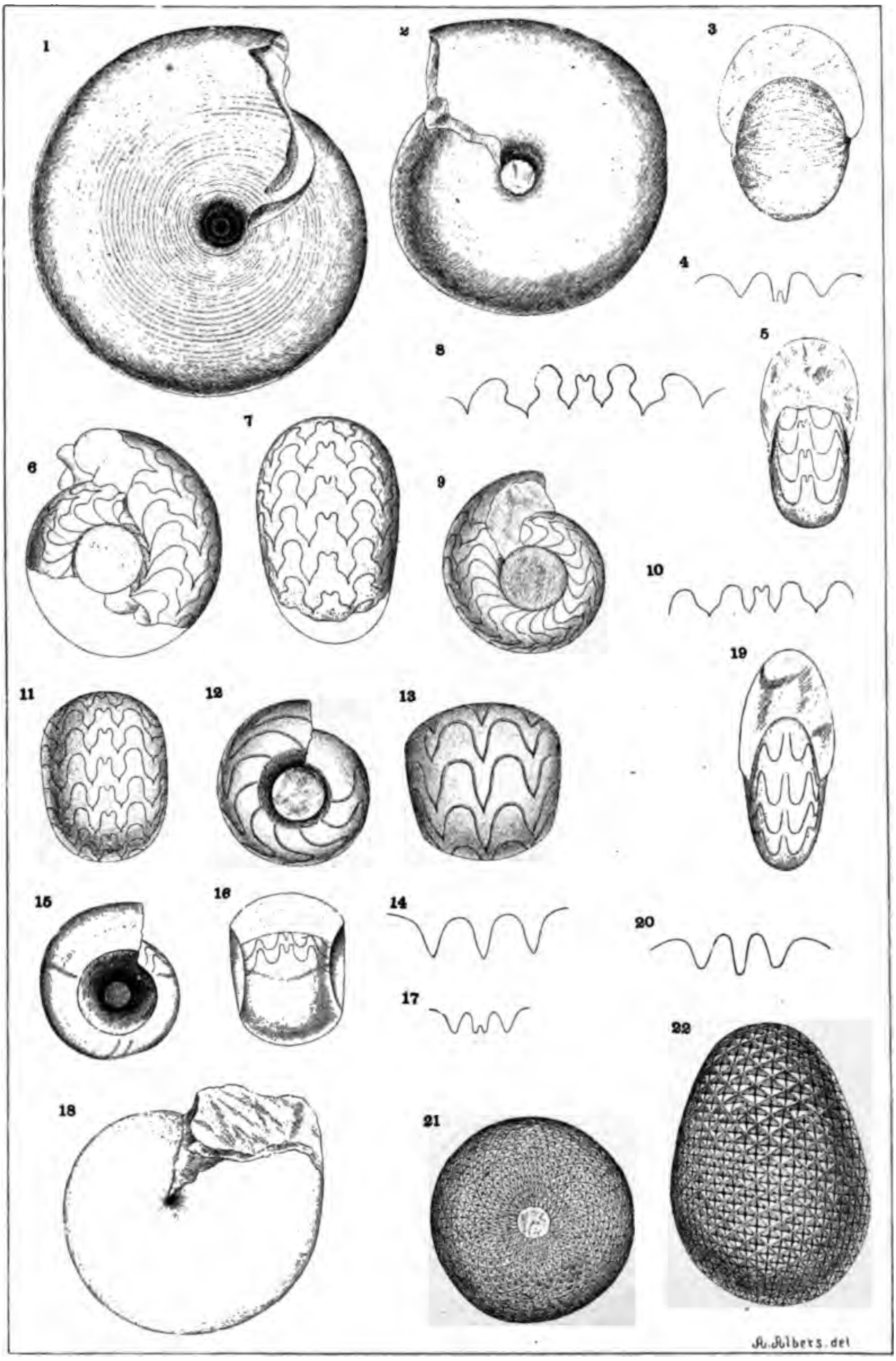
Bulletin No. 11. **Plate V.**



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BULLETIN NO. 12

OF THE

ILLINOIS STATE MUSEUM

OF

NATURAL HISTORY.

NEW SPECIES OF CRINOIDS CEPHALOPODS AND OTHER PALÆOZOIC FOSSILS.

By S. A. MILLER and WM. F. E. GURLEY.

Springfield, Illinois,
January 25, 1897.

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NEW SPECIES OF CRINOIDS, CEPHALOPODS AND OTHER PALÆOZOIC FOSSILS.

BY S. A. MILLER AND WM. F. E. GURLEY.

SUBKINGDOM ECHINODERMATA.

CLASS CRINOIDEA.

ORDER PALÆOCRINOIDEA.

FAMILY ACTINOCRINIDÆ.

AGARICOCRINUS IOWENSIS, n. sp.

Plate 1, fig. 1, basal view; fig. 2, summit view; fig. 3, azygous view of the same specimen.

Species large, subpentagonal in outline, by reason of the extension of the radial areas. Calyx very deeply concave, and vault correspondingly convex, leaving a thin visceral cavity. Plates thick, convex, and giving to the whole form a very rugged aspect. Of this species we have three specimens, two of them are substantially alike, though one has a more convex vault which is somewhat more evenly rounded.

Basals form a flat hexagonal disc somewhat larger than the diameter of the column. First primary radials about as long as wide, and gently curve from the basal disc so as to form a concave bottom for the cavity of the calyx; three hexagonal, two heptagonal. Second primary radials a little wider than long, quadrangular. Third primary radials very little larger than the second and wholly within the concavity of the calyx, three hexagonal, two pentagonal, axillary, and support on the superior sloping sides the secondary radials. First secondary radials large, tumid or highly convex, the inferior part is within the cavity of the calyx and the superior part curves over horizontally, in the direction of the arms. In the ray on the right of the azygous area, in the specimen illustrated, the first tertiary radials are somewhat trapezoidal in outline, and do not cover the superior faces of the first primary radials, and the second tertiary radials rest on both the secondary and first tertiary radials; they are axillary and bear upon each upper sloping side a free arm, which gives to this ray four arms. In the ray on the left of the azygous area the second secondary radial, on the proximal side, bears a single arm, there is an intercalated large plate resting in the angle formed by the two first primary radials, which is axillary and bears upon each superior side a tertiary radial that supports a single arm, which gives to this ray three arms. Each of the lateral rays is constructed in the same way, and each one bears three arms. In the ray opposite the azygous area each second secondary radial bears a single arm, which gives to this ray two arms. There are, therefore, fifteen arms in this species, and fifteen ambulacral openings to the vault, which are very conspicuous in a summit view. The secondary and tertiary radials are tumid and pyramidal plates. One of the other specimens has the four-armed ray on the left of the azygous area, and the three-armed ray on the right. We have elsewhere shown that, in our opinion, this variation should not be regarded as of specific importance. The arms are composed of a double series of interlocking plates and each one is in the form of a sharp angular ridge on the lower side.

The first regular interradials rest between the superior lateral sides of the first primary radials and extend as high as the third primary radials. In the area adjoining the four-armed ray, it is followed by two plates that separate the secondary radials and first arm plates and curve over the margin of the calyx and unite with three plates belonging to the vault. In the area next to the left of the azygous area there are also three plates, but one of them is intercalated and rests on the top of the first secondary radial, and is cut off from uniting with the plates of the vault. In each of the other two areas there are only two plates, the second ones of which curve over the margin of the calyx and unite with the plates of the vault. Each of these plates in the second ranges are longitudinally convex or bear an elongated node. There are four plates in the azygous area. The first one is in line with the first primary radials and of about the same size. It is followed by three large and elongated plates in the second range that curve up out of the calicular cavity and over the margin of the calyx and unite with the plates of the vault.

The vault is highly convex and more or less concave in the interradial regions. There is a large tumid plate at the apex of the vault which is surrounded by eight plates, the two smaller ones of which unite with the minute plates that surround the azygous orifice. There is a large tumid plate over the junction of the ambulacral canals; the other plates of the vault are much smaller, but they are very irregular in size; the smallest ones are in the regular interradial and azygous areas. The azygous area is wide and covered by numerous plates. The orifice is at the superior part of a bulbous swelling and surrounded by small plates.

This is the first fifteen-armed species ever described and may be distinguished by that character alone. It is, however, to be distinguished by its general form, peculiar arrangement of the secondary radials, and by the regular interradial and azygous plates.

Found in the Keokuk group, at Keokuk, Iowa, and now in the collection of Wm. F. E. Gurley.

AGARICOCRINUS KEOKUKENSIS, n. sp.

Plate 1, Fig. 4, basal view; Fig. 5, summit view; Fig. 6, azygous view of same specimen.

Species large, subpentagonal, in outline, by reason of the extension of the radial areas, calyx very deeply concave and vault very highly convex leaving a thin visceral cavity, and, in these respects, very much resembling *A. iowensis* above described. Plates thick, convex, and giving to the whole form a rough aspect.

Basals form a slightly concave hexagonal disc that is substantially covered with the end of the column. First primary radials about as long as wide, and gently curve from the basal disc so as to form a concave bottom for the cavity of the calyx, three hexagonal, two heptagonal. Second primary radials nearly as long as wide, quadrangular. Third primary radials somewhat wider but not any larger than the second and wholly within the concavity of the calyx, pentagonal, axillary, and support on the upper sloping sides the secondary radials. First secondary radials large, tumid and having the inferior end within the cavity of the calyx, and the superior part curving over, horizontally, in the direction of the arms. In the ray on the left of the azygous area the first secondary radials are axillary and on each proximal side support two tertiary radials and on one distal side a single large tertiary radial and on the other, which adjoins the azygous area, three tertiary radials, which arrangement gives to this ray four arms. One of the lateral rays is constructed in a somewhat similar manner, though, on one of the proximal sides of the first secondary radials, there are two tertiary radials, and, on the other, there are three, and, on each of the distal sides, there are two tertiary radials, which gives to this ray four arms. In the ray on the right of the azygous area there is a pentagonal plate inserted in the angle formed by the first secondary radials which supports upon each of three sides a single tertiary plate; those resting on the lateral sides are also supported on the first secondary radials, which gives to this ray three arms. In the other lateral ray there is an hexagonal plate inserted in the angle formed by the first secondary radials, which bears upon one upper side a single plate that supports a single arm and upon each of two sides a plate that supports a single arm, and upon the other a plate that supports upon each of two sides a plate, that together support a single arm, which gives to this ray three arms. In the ray opposite the azygous area the first secondary radial supports on one side a single secondary radial that supports an arm and the other secondary radial supports two plates that support a single arm, which gives to this ray two arms. There are, therefore, sixteen arms in this species, and sixteen ambulacral openings to the vault, which are very conspicuous in a summit view. The arms are composed of a double series of interlocking plates and each one is in the form of a sharp angular ridge on the lower side.

In each regular interradial area there are three plates, one following the other. The first one rests between the superior lateral sides of the first primary radials and extends as high as the third primary radials. The second one extends about as high as the first secondary radials and the third one curves over the margin of the calyx and unites with the plates of the vault. In the azygous area there are six plates. The first one is in line with the first primary radials and about the same size. It is followed by three plates, the middle one of which curves up out of the calicular cavity and over the margin of the calyx and unites with the plates of the vault. Each lateral one extends about as high as the first secondary radials and is followed by another elongated plate that curves over the margin of the calyx and unites with the plates of the vault.

The vault is exceedingly convex and very slightly depressed in the interradial areas. There is a large tumid plate at the apex of the vault, which is surrounded by seven large tumid plates. There are three large tumid plates over the junction of the ambulacral canals in each of four of the radial series, and one over the junction of the ambulacral canals, in the ray opposite the azygous area. The other plates of the vault are much smaller, but very irregular in size, the smallest ones are in the regular interradial and azygous areas. The azygous area is wide and covered by numerous polygonal plates. The azygous orifice is at the superior part of a bulbous swelling and surrounded by small plates.

This is the first sixteen-armed species ever described except the *Actinocrinus* (?) *helice* of Hall to which it bears very little, if any, resemblance. It would seem to be as nearly related to *A. iowensis*, above described, as to any other species, but it is widely different from that species, in the azygous and interradial areas, in the secondary and tertiary radials. and in the plates of the vault, beside having sixteen arms while that species has only fifteen. It is a very strongly marked species.

Found in the Keokuk Group. at Keokuk, Iowa, and now in the collection of Wm. F. E. Gurley.

REMARKS ON AGARICOCRINUS.

Agaricocrinus is a well marked genus that does not graduate into any other nor toward any other through any of the species belonging to it. It is only known from the lower half of the Subcarboniferous System. It first makes its appearance in the Chouteau limestone. Here we find *A. blairi*, which has a subquadrate flattened body and bears only nine arms. The ray opposite the azygous area bears a single arm, and each of the other rays bears two. It is the only nine-armed species that has been described, and has very little resemblance in either form or structure to any genus or species that preceded it. There have been described, also, from the Chouteau limestone, three ten-armed species, viz.: *A. germanus*, which is a small species, having a flattened body and a tumid plate above each ambulacral orifice; the vault is covered by fewer plates than any other known species; *A. chouteauensis*, which has an abrupt basal depression, subconical vault, and unequal radial series; and *A. sampsoni*, which bears very large arms, in proportion to the size of the flattened calyx. These species are widely separated from each other and readily distinguished by any one having any knowledge of the structure of crinoids, but they are not linked by any series of gradation with any known genus or species belonging to an earlier age.

Prof. James Hall described twelve ten-armed species from the Burlington Group, viz.: *A. bellitrema*, *A. convexus*, *A. corrugatus*, *A. brevis*, *A. excavatus*, *A. inflatus*, *A. geometricus*, *A. ornotrema*, *A. pentagonus*, *A. planoconvexus*, *A. pyramidatus* and *A. stellatus*. Of these only eight, viz.: *A. excavatus*, *A. brevis*, *A. pyramidatus*, *A. stellatus*, *A. convexus*, *A. ornotrema*, *A. pentagonus*, and *A. geometricus* have been, in any manner, illustrated. We have had occasion to examine the definitions and illustrations as well as specimens belonging to these eight species and have found no synonymy among them. *A. bellitrema* has been called a synonym for *A. ornotrema*, and *A. corrugatus* has been called a synonym for *A. pyramidatus*; but *A. planoconvexus* and *A. inflatus*, from their definitions, seem to be good species. It would be very gratifying to have some one illustrate these two species, who has some knowledge of fossils, in order that they might take their rank with other described and illustrated forms. We described *A. illinoisensis*, which has a depressed body with a peculiar pentagonal outline and ten arms, from the Burlington Group. These are all the ten-armed species that have been described from this Group.

There have been described, from the Burlington Group, five twelve-armed species, viz.: *A. bullatus*, *A. fiscellus*, *A. nodosus*, *A. hodgsoni* and *A. adamsensis*, all of which have been illustrated, except *A. fiscellus*. It was described by Prof. Hall as an *Actinocrinus* and he said: "It is not of the type of *Agaricocrinus*, Troost, or *Amphoracrinus*." His definition, however, would lead us to suppose he had before him an *Agaricocrinus* and a distinct species. *A. bullatus*, Hall, and *A. nodosus*, Meek and Worthen, are distinct and well characterized species very far removed from *A. americanus*, with which they have been erroneously classed by some, as synonyms.

The above are all the species which have been defined from the Burlington Group, and, it will be noticed, that they possess either ten or twelve arms. Prof. Meek mentioned the fact that he had seen an eleven-armed specimen, but he did not describe it.

There have been described from the Keokuk Group, three ten-armed species, viz.: *A. arcula*, *A. whitfieldi* and *A. wortheni*. They have been quite fully illustrated and are very distinct species.

There have been described, from the Keokuk Group, eight twelve-armed species, all of which have been properly illustrated. They are as follows: *A. crassus*, *A. elegans*, *A. eris*, *A. indianensis*, *A. splendens*, *A. springeri*, *A. tuberosus* and *A. tugurium*. These species are widely different from each other and clearly distinct. *A. eris* is from Richfield, Ohio, and, at the time of its original definition, was referred to the Waverly Group; but the rocks are decidedly above the Waverly Group, and are now known to belong to the Keokuk.

A. tuberosus, Hall, is properly the type of the genus. Prof. Hall published Troost's Mss. definition of the genus (Geo. Sur. Iowa, 560), and said it was founded upon *A. tuberosus*, proposed by Troost, which he said had been later described by Roemer, under the name of *Amphoracrinus americanus*. Prof. Hall then proceeded to define *A. tuberosus* (Geo. Sur. Iowa, 617), and very fully described a twelve-armed species, which is very common about Keokuk, Iowa, and of which we have examined more than one hundred good specimens. The species described by Roemer, under the name of *Amphoracrinus americanus* has very little resemblance to it, and is, as we understand his illustration, a fourteen-armed species, and we have specimens of it collected at the typical locality in Tennessee, which bear fourteen arms. The Mss. name, *A. tuberosus*, Troost, has no validity, because he did not define the species and because no one else has published what he said about it. Prof. Hall used the specific name *tuberosus* supposing that he was applying it to the same form to which Troost had applied it and to which Dr. Roemer had given the name *americanus*; but he was applying it to quite a marked and different species which he carefully described, and which must bear his name, because a catalogue name does not preoccupy a word or give it any force as a specific name. The name is, therefore, *A. tuberosus*, Hall, and not *A. tuberosus*, Troost. Prof. Hall followed the definition of the genus, with the description of the species *A. bullatus*, and published the definition of *A. tuberosus* farther on in the book, but that does not affect the question of the type of the genus, for he very clearly set forth *A. tuberosus* as the type.

The mistake of calling *A. tuberosus* a synonym for *A. americanus* has, probably, been carried into the literature of the subject, because so few copies of Bronn's Lethea Geognostica, in which Roemer published his *A. americanus*, ever reached America. We have never been able to obtain a copy of the work, but Dr. Suess, of Philadelphia, has furnished us with a copy of the figures 15*a* and 15*b* and a translation of the definition which is as follows:

"Amphoracrinus americanus, n. sp.

"The whole surface is a somewhat depressed expansion of the lower half of the calyx, which gives to this species a widely different aspect from the type of the genus. It is also considerably smaller there than *A. gilbertsoni*. An examination of the figures will show the sculpturing of the plates which is characteristic of every species."

This definition would not be sufficient to establish a species, but the figure, 15*a*, gives an azygous side view of an *Agaricocrinus* and shows four arm openings, upon each side of the azygous area, and the figure 15*b* shows a basal view of the calyx, and that the ray on each side of the azygous area possesses four arms and each of the other three rays possesses two arms, which gives to the species fourteen arms. After receiving these drawings we were able to identify four specimens, from Roemer's type locality, at White Springs, Tennessee, with *A. americanus*. We have examined a great many specimens of *Agaricocrinus* from the Keokuk Group of Kentucky and Tennessee, but have not found a single specimen of *A. tuberosus*, Hall, among them.

Our specimens of *A. tuberosus* show a great variation in size, in the concavity of the calyx, and height of the vault. The proportional length of the secondary radials differs, in different specimens, and in some specimens the rays, on each side of the azygous area, are much more prolonged than in others, this is especially the case in large specimens, with a depressed convex vault; but the fundamental structure and arm formula remain so constant, that there is no difficulty in referring them to the same species.

There has been only one thirteen-armed species, *A. gorbyi*, described from the Keokuk Group.

There have been three fourteen-armed species described from the Keokuk Group, viz.: *A. americanus*, *A. dissimilis* and *A. profundus*. They are all very pronounced and distinct species.

There has only been one fifteen-armed species described from the Keokuk Group, viz.: *A. iowensis*, above defined.

A. keokukensis, as above described, has sixteen arms.

Agaricocrinus (?) *helice* described as *Actinocrinus helice* from the Waverly Group, at Richfield, Ohio, which, as above remarked, is from rocks above the Waverly Group and belonging to the Keokuk, has, as stated, in Ohio Pal., vol. 2, p. 163, an arm formula of $4+3+2+3+4=16$ arms, or $4+3+2+4+4=17$ arms. We are inclined to think that two species are described here under one name; but specimens from that locality are very poor, and those which we have, possess only sixteen arms, and we cannot throw any additional light upon the subject. The reference of the species, however, to *Agaricocrinus* is very doubtful.

Agaricocrinus nodulosus from the Keokuk Group has 17 arms. The arm formula is $4+4+2+4+3$. And *A. macadamsi* has 18 arms. The arm formula is $4+4+4+3+3$. This species is one of the largest, has the most numerous arms and belongs to the last of the race.

We have thus taken, briefly in review, all the species of *Agaricocrinus* that have been described. They belong to the Chouteau, Burlington and Keokuk Groups. Names have been given to forty two species. All of these have been illustrated except five, three of which are believed to be good and valid species and the other two may be classed as doubtful, because they were named thirty six years ago and have never been illustrated, and some authors have said they are synonyms. All we can say is that we have not identified them in our collections. It is very easy for some to say, that one species is a synonym for another, but the student will find that good authors rarely make a synonym, and, if one occurs, it is under such circumstances that ordinary prudence will not guard against it. We have seen ten-armed species described by Hall, from the Burlington Group, twelved-armed species described by Hall from the Bnrlington Group, twelve-armed species described by Meek & Worthen from the Burlington Group, and twelve-armed species described by Hall from the Keokuk Group, all of which have been finely illustrated, and occur, in Iowa and Illinois, classed as synonyms for *Agaricocrinus americanus*, which has never been described, but which is a fourteen-armed species, as shown by the illustrations, and has never been known to occur, except in the Keokuk Group of Tennessee. Such erroneous classifications are without any discrimination, and usually without examination, but there is no way of preventing the pretensions.

We would again call attention to the distribution of the species in the different Groups of rocks. The species from the Chouteau limestone are small and bear either nine or ten arms. Those from the Burlington Group are larger than those from the Chouteau, but are not as large, generally, as those from the Keokuk. The Burlington forms described possess either ten or twelve arms, but Prof. Meek mentioned a specimen with eleven arms which he thought was abnormal. Those from the Keokuk Group possess ten, twelve, thirteen, fourteen, fifteen, sixteen, seventeen or eighteen arms. The Chouteau forms have a depressed body, the calyx is almost flat and only slightly concave about the column, and the vaults are depressed convex or only moderately elevated. Some of the Burlington forms are constructed upon a somewhat similar plan, but others have a deeply concave calyx and highly convex vault. None of the Keokuk forms are like the Chouteau species, but some of them resemble some of the Burlington species, though generally they are more robust and have deeper calices and higher vaults.

The genus *Agaricocrinus* has not been found, so far as we are advised, in the Waverly Group of Ohio, in the Marshall Group of Michigan, in the Kinderhook Group of Indiana, Illinois or Iowa, notwithstanding there are numerous very fossiliferous localities, many of which, like Rockford, Indiana, and Burlington and Le Grand, Iowa, are famous almost all over the world. It occurs in rocks of that age only in the Chouteau limestone of Missouri. The genus has been recognized, however, at almost every locality where the Burlington or Keokuk Group has been determined, in Iowa, Missouri, Illinois, Indiana, Ohio, Kentucky and Tennessee. The abrupt appearance of the genus *Agaricocrinus* in the Chouteau limestone, in a single locality in Missouri, and its confinement to that geographical locality throughout that geological age, and its distribution over seven states during the two succeeding geological ages, that are represented by the Burlington and Keokuk Groups, and its abrupt disappearance before the close of the Keokuk age, is wholly a mystery to us, and can be in no manner accounted for by our knowledge of the theory of evolution. Sir Charles Lyell, in speaking of the distribution of living genera, said:

"Dr. Bachman pointed out to me ten genera of birds and ten of quadrupeds, all peculiar to North America, but each represented on the opposite side of the Rocky Mountains by distinct species. The theory of specific centers, or the doctrine that the original stock of each species of bird and quadruped originated in one spot only, may explain in a satisfactory manner one part of this phenomenon, for we may assume that a lofty chain of mountains opposed a powerful barrier to migration, and that the mountains were more ancient than the introduction of these particular quadrupeds and birds into the planet. But the limitation of peculiar generic types to certain geographical areas, now observed in so many parts of the globe, points to some other and higher law governing the creation of the species itself, which, in the present state of science, is inscrutable to us, and may, perhaps, remain a mystery forever. The adaptation of peculiar forms, instincts, qualities and organizations to the present geography and climate of a region, may be a part only of the conditions which govern in every case the relations of the animate beings to their habitations. The past condition and changes of the globe and its inhabitants, throughout the whole period when the different beings were entering, each in succession, upon the scene, and all the future conditions and changes to the end of vast periods, during which they may be destined to exist, ought to be known, before we can expect to comprehend why certain types were originally selected for certain areas, whether of land or water." [Second visit to the United States, Vol. 1, p. 223.]

These remarks were printed before the establishment of the theory of evolution which now prevails among the naturalists of all countries and which has expanded our notions of the development of species by combining with our knowledge of the never-ceasing change and variations of animals and plants the laws governing the survival of the fittest under other environments and conditions; but the same mystery surrounds the peculiar limitation of certain genera to small geographical areas that did when Lyell wrote the above quotation. And the Darwinian theory offers us no assistance in accounting for such a fossil genus as *Agaricocrinus*. We may suppose that the various species could have been evolved, in the geological ages, from one type; but granting as actual facts all that we may suppose, yet the beginning of the genus and the ending remain absolutely unaccounted for even in theory. The development of all vegetable and animal life from a single monad is quite as chimerical as the special creation of each species out of the elements or from nothing. The invertebrate fossils, from the palæozoic rocks, afford no evidence to prove such fanciful imaginations. They show us that species were subject to such variations as we find now among living species, and they preserve for us the evidences of injury inflicted during life, showing that they recovered from their afflictions and withstood their vicissitudes, as similar grades of animals do now; but the abrupt appearance of a distinct genus, in a given geological age, and its confinement to a limited geographical area, and then its absolute extinction when it seems to have reached its largest size and most complete development, must be the result of some law or combination of laws which we not only do not understand, but of which we have no rational conception.

The fossils are the facts and the evidence in palæontology, and they have been collected in detached and remote places and stored in different states. From having observed a very limited number of these facts some authors have built cloudy systems and made useless speculations that are mere rubbish in the way of progress. The fossils are the indexes of nature; they must be observed with the eye, and from their appearance only can we become acquainted with the anatomy or hard parts of the animals. Until we are thoroughly acquainted with the anatomy of an animal, we are unprepared to discuss its physiology. Physiology is the word used by the medical men to express the science which unfolds the nature of life, the etymology and original acceptation of which means the doctrine of nature, but Treviranus, a German author, at a comparatively recent date, proposed the term "biology" for science of life instead of physiology, and naturalists who are not medical men use the word "biology" exclusively, and medical men generally retain the older name "physiology" to express one and the same thing. The biology is inseparable from the anatomy. The biological functions are manifested as the anatomical parts are developed and completed; they are modified with the afflictions of the anatomy; they decline and decay with it, and the biological functions cease when the softer anatomical parts are destroyed.

It was not uncommon for naturalists in the last century to arrange, from a few specimens in a museum, what they supposed represented the animal kingdom, in a successive series of development governed by the external appearances. They followed the chain, as they supposed, link after link, without a break, innocent of the fact that the internal comparative anatomy, when examined, would break the chain into fragments and wholly destroy the fancy of the gradual ascension and progression. We think we have seen in recent palæontological productions the arrangement of fossil shells, in successive series, from species to species, through different geological ages, as if they formed a chain in evolution, but it will separate, link after link, in like manner, under the glance of a scientist.

A knowledge of evolution followed the domestication of animals centuries ago but how and where it takes place is a subject of modern investigation. And we do not know how or where it has taken place, except as a result of observation and experiment. The theory of evolution does not account for anything, though an established fact may be consistent with the theory. All biological knowledge follows the discovery of the hard and soft parts of the anatomy of living animals, but among extinct fossil animals it is only to be inferred after a full knowledge of the hard parts found preserved. And *Agaricocrinus* is a good genus with which to make an illustration. We know that some crinoids, as *Eucalyptocrinus*, were permanently attached by roots that penetrate the mud, at the bed of the sea, like a forest tree penetrates the soil on land, that others, like *Anomalocrinus* attached roots to foreign objects, or were free, like *Pycnocrinus*, and though floaters could attach themselves by coiling the tapering ends of their columns around other objects; but we do not know to which of these divisions *Agaricocrinus* belonged. We know that the columns in some crinoids were square, others pentagonal and others round and that the column of *Agaricocrinus* was round; but we do not know what significance, if any, in the line of development, is to be attached to the form of the column, its structure, or the shape of the columnar canal. We know nothing of the internal anatomy of the calyx or head of *Agaricocrinus* and cannot trace the source of the genus, if it is to be found, in known species of earlier age or find the evidences of its survival, if it did survive, in later crinoidal forms.

We know by the three basals, absence of subradials, presence of primary radials and regular interradials, that *Agaricocrinus* must be classed, in the family *Actinocrinidæ*, which is established on the hard parts of the fossilized tests, and which has had no representative, so far as discoveries have progressed, since the Subcarboniferous age. They ante-date the Carboniferous period. An old English naturalist said, "Providence maintains and continues every created species; and we have as much assurance, that no races of animals will any more cease, while the earth remaineth, than seed time and harvest, cold and heat, summer and winter, day and night." But we have, on the contrary, every assurance that observation, discovery and study has offered, not only that the forty-two species of *Agaricocrinus* were confined to the geological ages, from which they have been described, but that the genus and the entire family of genera to which it belonged, so far as the biological part or the physiological functions of the animals are concerned, were annihilated absolutely from the face of the earth, in the Subcarboniferous period of geological time. They were not annihilated at the same time nor by any convulsion of nature. Instead of one species graduating into another, by improvement or decline, which may possibly have been the case, in some instances of which we have no proof, the general rule was that one species became extinct at one time and place, and another became extinct at another time and at another place, and, in this way, not only the forty-two species which are now known were obliterated, but all the unknown species belonging to the genus, and all allied genera which belonged to the same family were annihilated before the Coal Measures or Carboniferous period.

BATOCRINUS SHARONENSIS, n. sp.

Plate I, Fig. 7, azygous side view; Fig. 8, opposite view; Fig. 9, lateral view.

Species medium size, somewhat biturbinate. Calyx funnel shaped, rapidly expanded at the arms, a little less than twice as wide as high. No radial ridges, surface plane and smooth or, possibly, finely granular. Ambulacral openings directed a little above a horizontal line, and not visible in a basal view. An ovarian pore on each side of the pair of arms opposite to the azygous area, and they are all we have detected in two finely preserved specimens.

Basals form a disc about four times as wide as high. It bears a slight band and has an hemisperical depression for the attachment of the column. First primary radials large and wider than long, three hexagonal, two heptagonal. Second and third primary radials together smaller than the first. Second primary radials quadrangular, two or three times as wide as long. Third primary radials very little larger than the second, pentagonal, axillary, and in the ray opposite the azygous area bears upon each upper sloping side three secondary radials, which gives to this ray two arms. In each of the lateral rays the third primary radial bears upon each upper sloping side two secondary radials, the last ones being axillary, and bearing upon each upper sloping side two tertiary radials, which gives to each of these rays four arms. The third primary radial on each side of the azygous area bears upon the distal side three secondary radials and upon the proximal side two secondary radials, the last being axillary, and bearing upon each upper sloping side two tertiary radials, which gives to each of these rays three arms. There are, therefore, sixteen arms in this species. The arm formula is 3+4+2+4+3.

There are two plates in each regular interradial area, the first one is nearly as large as a first primary radial, and the second one is quite small and cut off from the vault by the union of two secondary radials, or two tertiary radials, in each adjacent ray. In the azygous area there are seven plates. The first one is in line with the first primary radials and as large as either of them. It is followed by three rather large plates, in the second range, and above these upon the right side and superior part of the middle one there are two plates, one of which is followed by a small plate that separates the tertiary radials and unites with the plates of the vault.

The vault is unsymmetrical. It is most tumid above the four armed rays and somewhat longitudinally depressed on the azygous side. The plates are convex, and there is a large subcentral proboscis.

The shape of the vault reminds one of the vault in *Batocrinus pyramidatus*, but the two species are so widely separated, in all the material parts of the structure, that no comparison is necessary. In structure it comes nearer *Batocrinus cognatus* than to any other species, though the arm formulas are different and there are more secondary and tertiary radials in this species than in that one. In general appearance there is very little resemblance between the two species.

Found by R. A. Blair, in the Burlington Group, near Sharon, in the southwestern part of Missouri, and now in the collection of S. A. Miller.

BATOCRINUS SCITULUS n. sp.

Plate 1, Fig. 10, azygous side; Fig. 11, opposite view.

Species medium size, biturbinate. Calyx obconoidal, about one-fourth wider than high. No radial ridges. Plates very slightly convex except the first primary radials and first azygous plate, each of which bears a central node. Ambulacral openings directed a little above a horizontal line. No ovarian pores discovered.

Basals form a round cup about twice as wide as high. It bears a well-defined band, and has an hemispherical depression for the attachment of the column. First primary radials large, a little longer than wide, three hexagonal, two heptagonal. Second and third primary radials together not as large as the first. Second primary radials quadrangular, about twice as wide as long. Third primary radials very little larger than the second, one heptagonal, two hexagonal, two pentagonal, axillary, and, in the ray opposite the azygous area, bears upon each upper sloping side two secondary radials, which gives to this ray two arms. In each of the other rays the third primary radial bears, upon each upper sloping side, a single secondary radial, which is comparatively large, axillary and bears upon each upper sloping side a single tertiary radial, except, in the ray adjoining the azygous area, where there are two tertiary radials, which gives to each of four rays four arms. There are, therefore, eighteen ambulacral openings to the vault, in this species. The arm formula is 4+4+2+4+4. There is a small intercalated plate above the third primary radial, in the ray on the right of the azygous area, in the specimen illustrated. It is this intercalated plate that makes the third primary radial heptagonal. We suppose this feature to be abnormal, and, therefore, not of specific importance.

There are two plates, in each regular interradial area, one large, the other small and cut off from all connection with the vault by the union of the radials above. In the azygous area there are eight plates. The first one is in line with the first primary radials and of about the same size. It is followed, in the second range, by three plates, and above these there are four smaller ones that are cut off from any connection with the plates of the vault by the union of the second tertiary radials above them.

The vault is nearly as large as the calyx and bears a very large central proboscis. It is covered by numerous slightly convex polygonal plates.

This species has its affinities with *B. affinis*, which is a twelve armed species, *B. approximatus*, a thirteen armed species, *B. verneuilianus*, a fourteen armed species, *B. variabilis*, a fifteen armed species, *B. cognatus*, a sixteen armed species, and *B. consanguineus*, a twenty armed species. It will be distinguished from these species by the arm formula and eighteen ambulacral openings to the vault.

Found by R. A. Blair, in the Burlington Group, near Sharon, in the southwest part of Missouri, and now in the collection of S. A. Miller.

BATOCRINUS SENEX, n. sp.

Plate I, Fig. 12, azygous side; Fig. 13, opposite view of same specimen; Fig. 14, summit view of another specimen.

Species below medium size, biturbinate. Calyx obconoidal, most rapidly spreading at the arms, more than one and a half times as wide as high. No radial ridges, but depressed at the upper part of the interradial areas leaving the radial series projecting at the bases of the arms. Plates smooth, the larger ones slightly convex. Ambulacral openings not visible in a basal view, but conspicuous in a summit view. An ovarian pore on each side of the radial series opposite the azygous area, others not discovered.

Basals form a low expanding cup nearly four times as wide as high and having an hemispherical depression below, for the attachment of the column, which has a diameter equal to the truncated end of the calyx. No basal rim. First primary radials large, nearly as long as wide, three hexagonal, two heptagonal. Second primary radials quadrangular, two or three times as wide as long, and less than half as large as the first. Third primary radials about half as large as the first, the two adjoining the azygous area hexagonal, the other three pentagonal, and in the ray opposite the azygous area supports on each upper sloping side two secondary radials, which gives to this ray two arms. In each of the lateral rays the third primary radial bears upon one upper sloping side three secondary radials and upon the other two secondary radials, the last being axillary and supporting, on each upper sloping side, a single tertiary radial, which gives to each of these rays three arms. In the ray on each side of the azygous area, the third primary radial bears upon the distal side three secondary radials and upon the proximal side two secondary radials, the last being axillary and bearing, upon one upper side, a single tertiary radial, and upon the other two tertiary radials, which gives to each of these rays three arms. There are, therefore, fourteen arms in this species. The arm formula is 3+3+2+3+3.

In each of three regular interradial areas, there are three plates, one in the first range and two elongated plates in the second range, one of which connects with a plate belonging to the vault. In the other regular area there are four plates, one in the first range, two in the second and one in the third, which unites with the plates of the vault. In the azygous area there are seven plates. The first one is in line with the first primary radials and about the same size. It is followed by three plates in the second range and three in the third range, the middle one of which connects with the plates of the vault.

The vault is conical and bears a large central proboscis. It is covered with numerous convex polygonal plates.

This species, no doubt, has some affinity with *B. verneuilianus*, but not much with any other fourteen-armed species. In general appearance it does not bear much resemblance to *B. verneuilianus*, because the form and proportion of the plates are so different; beside the interradial areas and number of interradial plates are different and the number of secondary and tertiary radials do not agree, though each has fourteen ambulacral openings to the vault.

Found by R. A. Blair, in the Burlington Group, near Sharon, in Southwest Missouri, and now in the collection of S. A. Miller.

BATOCRINUS RELIQUUS, n. sp.

Plate I, Fig. 15, basal view; Fig. 16, azygous side; Fig. 17, summit view.

Species below medium size, biturbinate or somewhat wheel-shaped. Calyx very rapidly spreading at the arms, where it is more than twice as wide as high. No radial ridges, but the radial series are somewhat lobed and project at the margin so as to notch the circumference at the interradial parts. Plates finely granular, the larger ones slightly convex. Ambulacral openings directed horizontally and not visible in a basal view. No ovarian pores discovered.

Basals form a very short rapidly expanding cup four times as wide as high. No basal rim. First primary radials larger than the second and third together, three hexagonal, two heptagonal. Second primary radials quadrangular, two or three times as wide as long. Third primary radials a little larger than the second; each one of them is hexagonal, axillary, and in each of the lateral rays and in the ray opposite the azygous area support, on each upper sloping side, two secondary radials, which gives to each of these three rays two arms. In the ray on each side of the azygous area the third primary radial supports, on the distal side, two secondary radials, and on one of the proximal sides two secondary radials, the last being axillary and supporting on each upper side a tertiary radial, and on the other proximal side one secondary radial, which is axillary, and supports on each upper side a tertiary radial, which gives to each of these two rays three arms. There are, therefore, twelve arms in this species. The arm formula is 3+2+2+2+3.

In each of three regular interradial areas there are three plates—one in the first range and two in the second, both of which connect with the plates of the vault; in the other area there are four plates, two of which connect with the plates of the vault. In the azygous area there are seven plates. The first is in line with the first primary radials and fully as large as either of them. It is followed by three plates in the second range, the middle one of which connects with the plates of the vault. On the left of the upper part of this elongated plate there is one plate that connects with the vault, and on the right there are two plates, one of which connects with the vault. There are, therefore, three azygous plates, in a wide area, that connect with the vault.

The vault is pyramidal, by reason of being depressed in the interradial areas, and bears a large central proboscis. It is covered with convex, polygonal plates.

This species is so distinct from all other twelve-armed species, in general appearance as well as in the general structure, that no comparison is necessary.

Found by R. A. Blair, in the Burlington Group, near Sharon, in Southwest Missouri, and now in the collection of S. A. Miller.

BATOCRINUS RUSTICELLUS, n. sp.

Plate I, Fig. 18, basal view; Fig. 19, same, magnified two diameters; Fig. 20, azygous side; Fig. 21, summit view.

We have three specimens of this species, one of which is twice as large as the one illustrated. The species, may, therefore, be said to be medium or slightly below medium in size, biturbinate or somewhat wheel-shaped, the larger specimen more wheel-shaped than the one illustrated. Calyx very rapidly spreading at the arms; where it is from two to two and a half times as wide as high. No radial ridges, but the radial series are slightly lobed and project at the margin so as to notch the circumference at the interradial spaces. Plates plane and finely granular. Ambulacral openings not visible in a basal view, but may be seen in a summit view. One ovarian pore on each side of each radial series may be plainly seen in the larger specimen, but only part of them can be seen in the specimen illustrated.

Basals form a short round disc, having an hemispherical depression for the attachment of the column. First primary radials as large as the second and third together, wider than long, three hexagonal, two heptagonal. Second primary radials quadrangular, two or two and a half times as wide as long. Third primary radials larger that the second, two hexagonal, three pentagonal, axillary, and in the ray opposite the azygous area supports, on each upper sloping side, three secondary radials, which gives to this ray two arms. In one lateral ray the third radial bears two secondary radials on each upper side, and in the other only one, the last being axillary and supporting upon each upper side two tertiary radials, which gives to each of these rays four arms. In the ray on each side of the azygous area the third primary radial supports, on the distal side, three secondary radials, and on one of the proximal sides one axillary secondary radial, which bears on each side two tertiary radials and on the other proximal side two secondary radials, the last being axillary and supporting on each upper side two tertiary radials, which gives to each of these rays three arms. There are, therefore, sixteen ambulacral openings to the vault in this species. The arm formula is 3 : 4+2+4+3.

There are three plates in each regular interradial area, one. followed by two, which are cut off from all connection with the vault by the union of the radials above them. There are only four plates in the azygous area. The first one is in line with the first primary radials and about the same size. It is followed by three plates, the middle one being quite large, but cut off from the vault by the union of the tertiary radials above it.

The vault is nearly as large as the calyx and bears a small central proboscis. It is covered with convex, polygonal plates and is slightly lobed over the ambulacral canals.

It is a marked species in its general appearance and need not be compared with any other sixteen-armed species to distinguish it.

Found by R. A. Blair, in the Burlington group, near Sharon, in Southwestern Missouri, and now in the collection of S. A. Miller.

BATOCRINUS RESERVATUS, n. sp.

Plate 1, Fig. 22, basal view magnified two diameters; Fig. 23, same natural size; Fig. 24, azygous side; Fig. 25, summit view.

Species below medium size, biturbinate, wheel-shaped. Calyx very rapidly spreading at the arms, where it is twice as wide as high. No radial ridges, but the radial series are lobed and project at the margin so as to notch the circumference at the interradial spaces. Plates plane and smooth, or finely granular. Ambulacral openings directed upward and not visible in a basal view, but fully exposed in a summit view. An ovarian pore may be seen on each side of each radial series, the opening is through the last radial and is small so as not to be very distinct.

Basals form a short, round, expanding cup, twice as wide as high, and having an hemispherical depression for the attachment of the column. First primary radials as large as the second and third together, wider than long, three hexagonal, two heptagonal. Second primary radials, quadrangular, about twice as wide as long. Third primary radials a little larger than the second, three hexagonal, two pentagonal, axillary, and, in the ray opposite the azygous area, supports, on each upper sloping side, three secondary radials, which gives to this ray two arms. In one of the lateral rays, the third primary radial supports, on each upper side, two secondary radials, the last ones axillary and supporting, on the distal sides, two tertiary radials, and, on the proximal sides, one, which gives to this ray four arms. In the other lateral ray, there are three secondary radials on one side, and two on the other, the last one being axillary and supporting, on each side, two tertiary radials, which gives to this ray three arms. In the ray, on each side of the azygous area, the third primary radial bears, upon each distal side, three secondary radials, and, upon each proximal side, two secondary radials, the last being axillary and supporting on each upper side, two tertiary radials, which gives to each of these rays three arms. There are, therefore, fifteen arms in this species. The arm formula is 3+4+2+3+3.

In each regular interradial area there are three plates—one in the first range, followed by two elongated plates in the second range that unite with the plates of the vault. In the azygous area there are four plates. The first one is in line with the first primary radials and about the same size. It is followed by three large plates, the middle one of which is much elongated and unites with the plates of the vault.

Vault pyramidal by reason of the depressed interradial areas, nearly as large as the calyx, and bears a central proboscis. It is covered by convex, polygonal plates.

This species bears little or no resemblance to any other fifteen-armed species. When compared with *B. rusticellus* above described, it will be seen that it bears sixteen arms and that neither the azygous area nor any of the interradial areas connect with the vault, while this species bears fifteen arms and all the areas are widely connected with the vault. A close inspection shows a difference in structure in nearly all respects. Like differences will be found when compared with other species.

Found by the veteran collector, R. A. Blair, to whom science is so much indebted for unremitting labor, in the Burlington Group, near Sharon, in the Southwestern part of Missouri, and now in the collection of S. A. Miller.

BATOCRINUS ROTULIFORMIS, n. sp.

Plate I, Fig. 26, basal view magnified two diameters; Fig. 27, same natural size. Plate II, Fig. 1, azygous view; Fig. 2, summit view.

Species below medium size, biturbinate, wheel-shaped. Calyx curving outward from the base to the arms, more than twice as wide as high. No radial ridges, but the radial series are lobed and project at the margin so as to notch the circumference at the interradial spaces. Plates convex and finely granular. Ambulacral openings directed slightly above an horizontal line, not visible in a basal view, but may be seen in a summit view. No ovarian pores detected, and probably they open through the first arm plate.

Basals form a short hexagonal disc five times as wide as high, notched at the sutures, and having an hemispherical depression for the attachment of the column. First primary radials not as large as the second and third together, about twice as wide as long, three hexagonal and two heptagonal. Second primary radials quadrangular, from three to five times as wide as long. Third primary radials about one half larger than the second, four hexagonal, one heptagonal, axillary, and the ray opposite the azygous

BATOCRINUS RESERVATUS, n. sp.

Plate 1, Fig. 22, basal view magnified two diameters; Fig. 23, same natural size; Fig. 24, azygous side; Fig. 25, summit view.

Species below medium size, biturbinate, wheel-shaped. Calyx very rapidly spreading at the arms, where it is twice as wide as high. No radial ridges, but the radial series are lobed and project at the margin so as to notch the circumference at the interradial spaces. Plates plane and smooth, or finely granular. Ambulacral openings directed upward and not visible in a basal view, but fully exposed in a summit view. An ovarian pore may be seen on each side of each radial series, the opening is through the last radial and is small so as not to be very distinct.

Basals form a short, round, expanding cup, twice as wide as high, and having an hemispherical depression for the attachment of the column. First primary radials as large as the second and third together, wider than long, three hexagonal, two heptagonal. Second primary radials, quadrangular, about twice as wide as long. Third primary radials a little larger than the second, three hexagonal, two pentagonal, axillary, and, in the ray opposite the azygous area, supports, on each upper sloping side, three secondary radials, which gives to this ray two arms. In one of the lateral rays, the third primary radial supports, on each upper side, two secondary radials, the last ones axillary and supporting, on the distal sides, two tertiary radials, and, on the proximal sides, one, which gives to this ray four arms. In the other lateral ray, there are three secondary radials on one side, and two on the other, the last one being axillary and supporting, on each side, two tertiary radials, which gives to this ray three arms. In the ray, on each side of the azygous area, the third primary radial bears, upon each distal side, three secondary radials, and, upon each proximal side, two secondary radials, the last being axillary and supporting on each upper side, two tertiary radials, which gives to each of these rays three arms. There are, therefore, fifteen arms in this species. The arm formula is 3+4+2+3+3.

In each regular interradial area there are three plates—one in the first range, followed by two elongated plates in the second range that unite with the plates of the vault. In the azygous area there are four plates. The first one is in line with the first primary radials

BATOCRINUS (?) RUSTICUS, n. sp.

Plate II, Fig. 3, basal view magnified two diameters; Fig. 4, same natural size; Fig. 5, azygous side; Fig. 6, summit view.

Species rather below medium size, calyx and vault somewhat equal and together somewhat lenticular. Ambulacral openings directed horizontally and not visible in either a basal or summit view. Calyx very rapidly spreading from the basal disc, slightly depressed in the interradial areas, and lobed over the radial series. No radial ridges, but the radial series project so as to notch the circumference at the interradial spaces. Ovarian pores not discovered.

Basal plates very short and form a hexagonal disc bearing a concave depression for the attachment of the column. First primary radials larger than the second and third together, wider than long, three hexagonal, two heptagonal. Second primary radials quadrangular, from four to six times as wide as long. Third primary radials a little larger than the second, pentagonal, axillary, and the ray opposite the azygous area, supports, on each upper sloping side, three secondary radials, which gives to this ray two arms. In each of the other four arms, the third primary radial supports, on each upper sloping side, two secondary radials, the last being axillary and supporting, on each upper sloping side, two tertiary radials, which gives to each of these rays four arms. There are, therefore, eighteen ambulacral openings to the vault, in this species. The arm formula is 4 4 2 4 4.

There are three plates in each regular interradial area, one in the first range, followed by two narrow elongated plates, in the second range, that unite with the plates of the vault. In the azygous area there are six plates. The first is in line with the first primary radials and narrower and smaller than either of them. It is followed by three plates, in the second range, and two in the third range, that unite with the plates of the vault.

Vault convex and bears a rather large, convex, central plate, surrounded by seven plates, three of which adjoin the small plates that surround the azygous orifice. The plates over the ambulacral canals are large and tumid, those in the interradial areas smaller and less convex. The azygous orifice is small, somewhat elevated, and subcentral.

area supports, on each upper sloping side, three secondary ralials, which gives to this ray two arms. In each of the lateral rays and in the ray on the right of the azygous area the third primary radial supports, upon one upper side, three secondary radials and upon the other two, the last one being axillary and supporting, on each upper side, two tertiary radials, which gives to each of these rays three arms. In the ray on the left of the azygous area the third primary radial bears, upon each upper sloping side, two secondary radials, the last being axillary and supporting, on each upper sloping side, two tertiary radials, which gives to this ray four arms. There are, therefore, fifteen arms in this species. The arm formula is 3+3+2+4+3.

In each regular interradial area, there are three plates, one in the first range followed by two elongated plates, in the second range; that unite with the plates of the vault. In the azygous area there are seven plates. The first one is in line with the first primary radials and about the same size. It is followel by three plates, in the second range, and these by three plates, in the third range, all three of which unite with the plates of the vault.

Vault pyramidal by reason of the depressed interradial areas, larger than the calyx, and bears a large central proboscis. It is covered by large convex, polygonal plates.

This species is most nearly related to *B. reservatus*, above described, from which it is distinguished, by the hexagonal disc, formed by the basal plates, instead of a round expanding cup; by the azygous area, which has seven plates, three of which unite with the plates of the vault, instead of four plates, only one of which connects with the vault; by the larger vault which is covered with larger and more convex plates; and by the arm formula which is 3+3+2+3 4, instead of 3 4 2 3 3. There are minor differences as may be seen by comparing the descriptions. It need not be compared with any other species.

Found by R. A. Blair, in the Burlington Group, near Sharon, in southwestern Missouri, and now in the collection of S. A. Miller.

with this species, though they are pressed somewhat out of shape, except in one particular. They have three ambulacral openings to the vault, in the ray opposite the azygous area, which gives to each nineteen arms. In a better state of preservation they might show other differences, and may belong to another closely related species.

Found by R. A. Blair, in the Burlington Group, near Sharon, in southwestern Missouri, and now in the collection of S. A. Miller.

STEGANOCRINUS SHARONENSIS, n. sp.

Plate II, fig. 10, azygous side; fig. 11, opposite view; fig. 12, vault.

Species small. Calyx obpyramidal, rather broadly truncated, pentagonal as seen from below or above. Plates thick, nodose, pyramidal. Column large, canal small.

Basals form a short, hexagonal cup, deeply notched at the sutures. Plates below somewhat cuneiform. First primary radials rather large, nodose, wider than long, three hexagonal, two heptagonal. Second primary radials about two-thirds as large as the first, sculptured in like manner, wider than long, hexagonal. Third primary radials smaller than the second, pentagonal, axillary and support on each upper sloping side a single secondary radial which is axillary, and beyond which the plates are not preserved in our specimens. There do not appear to be more than ten openings to the vault, but they are large and the axillary plates show twenty arms.

The interradial areas all graduate up into the vault and over the ambulacral channels so as to leave no dividing line between the vault and calyx. The regular interradial areas are not uniform. The first plate is followed in each area by two smaller plates in the second range. In each of two areas there are two plates in the third range, and in the other areas three plates, and these separate the arms and unite with plates that may be regarded as vault plates. In the azygous area the first plate is in line with the first primary radials and about the same size. It is followed by two plates in the second range, three in the third range, three in the fourth range, and three in the fifth range, that separate the arms.

The vault is only slightly convex and only moderately elevated over the ambulacral canals and bears a subcentral proboscis. It is covered with convex and nodose polygonal plates.

In the subpentagonal outline of the calyx, short form, and in the character of the vault this species allies itself with *Agaricocrinus*; but in the plates of the calyx, and in their arrangement, it is a true *Batocrinus*. If the arms were preserved, we might be disposed to refer it to *Agaricocrinus*, notwithstanding the plates and form of the calyx. We have referred it to *Batocrinus* with doubt. If there has ever been a link discovered that connects *Batocrinus* with *Agaricocrinus*, by any chain of development, it is to be found, in this species. All authors who lay stress upon the characters of the vault will unhesitatingly refer this species to *Agaricocrinus*. But no eighteen armed *Agaricocrinus* has ever been found, in the Burlington Group, and only one in the Keokuk, and it is a pronounced *Agaricocrinus*. Typical *Agaricocrinus* appear in the Chouteau with ten and twelve arms and they are quite as early as any *Batocrinus*. *Batocrinus* with eighteen and more arms are common in the Burlington. This cannot be the species through which *Batocrinus* developed into *Agaricocrinus*, nor through which *Agaricocrinus* developed into *Batocrinus*, because it is not found in rocks early enough for such transition. It is only indicative of an apparent affinity, when both genera were in the mature state of their existence. The stratigraphical position with the eighteen armed structure is in favor of classifying it with *Batocrinus*.

Found in the Burlington Group, by R. A. Blair, near Sharon, in southwestern Missouri, and now in the collection of S. A. Miller.

BATOCRINUS DOUGLASSI, n. sp.

Plate II, Fig. 26, view opposite the azygous area.

Species medium size, biturbinate. Calyx obconoidal, about twice as wide as high. Radial ridges rounded, and all the plates radiately sculptured. Truncated only the diameter of the column.

Basals form a very short hexagonal disc. First primary radials much wider than long, three hexagonal, two heptagonal. Second primary radials about half as large as the first, and about half as long as wide, quadrangular. Third primary radials larger than the second, pentagonal, axillary, and support on each upper sloping side a single secondary radial which is axillary, and, upon the distal sides, support four tertiary radials, before the arms become free; upon each proximal side there is a single tertiary radial, which is axillary and supports three quaternary radials before the arm becomes free.

Found in the Burlington Group, at Burlington, Iowa, and now in the collection of A. Albers, in whose honor we have proposed the specific name.

STEGANOCRINUS GRIFFITHI, n. sp.

Plate II, Fig. 17, azygous side; Fig. 18, opposite view; Fig. 19, basal view; Fig. 20, summit view.

Species small. Calyx obpyramidal, broadly truncated, pentagonal as seen from above or below. Plates nodose, pyramidal.

Basals form a short, hexagonal cup, deeply notched at the sutures. First primary radials large, nodose, pyramidal, wider than long, three hexagonal, two heptagonal. Second primary radials about half as large as the first, wider than long, hexagonal. Third primary radials smaller than the second, pentagonal, axillary, and beyond these plates our specimen is not preserved. Ten ambulacral openings penetrate the vault.

The interradial areas all graduate up into the vault and over the ambulacral channels so as to leave no dividing line between the vault and calyx. The first regular interradial is followed by two plates that unite with two plates that belong to the vault and two that cover part of the ambulacral canals. In the azygous area, the first plate is in line with the first primary radials, but somewhat smaller. It is followed by two plates in the second range and three in the third that unite with the plates of the vault and those covering part of the ambulacral channels.

The vault is only slightly convex and bears a central proboscis. It is covered with rather large convex plates.

This species most resembles *S. sharonensis*, from which it is distinguished by the character of the ornamentation, by the form of the basal plates, and by having a less number of plates in the interradial areas and upon the vault. The vaults are so different that the two species will not be taken for each other.

Found in the Burlington Group, at Burlington, Iowa, by Dr. H. G. Griffith, formerly of that place, but now residing in Philadelphia. We take pleasure in dedicating this species to the learned doctor and naturalist who discovered it. It is now in the collection of Mr. A. Albers.

STEGANOCRINUS BLAIRI, n. sp.

Plate 11, Fig, 21, view opposite the azygous side, all the arms, except one, broken off at the calyx; Fig. 22, basal view, part of the sutures destroyed.

Species medium size. Calyx urn-shaped, transverse section subpentagonal. Plates thick, radiately sculptured, the larger ones having a small central node.

Basals form a subhexagonal, sculptured disc four or five times as wide as high. First primary radials a little wider than long, three hexagonal, two heptagonal. Second primary radials only a little smaller than the first, hexagonal. Third primary radials a little smaller than the second, pentagonal, axillary, and support on each upper sloping side a single secondary radial, which is axillary, and supports on each upper sloping side tertiary radials. Two tertiary radials are preserved in our specimen and there is a small plate resting in the angle between the two secondary radials that separates the first proximal tertiary radials. This species has at least twenty ambulacral openings to the vault.

The first regular interradial in each area is followed by a range of plates, two of which are directly above it and unite with the plates of the vault, and upon each side of these the plates are continued out upon the side of the radial series and cover part of the ambulacral channel. In the azygous area, the first plate is in line with the first primary radials and about the same size. It is followed by two plates in the second range, above which there are three plates that unite with the plates of the vault and upon each side of these the plates are continued out upon the side of the radial series and cover part of the ambulacral channel.

The vault is highly convex, much elevated over the ambulacral canals, and bears a large central proboscis. It is covered by convex and nodose, polygonal plates.

This species is a true *Steganocrinus* and very readily distinguished from all that have been heretofore described.

Found by R. A. Blair, in whose honor we have proposed the specific name, in the Burlington Group, near Sharon, in Southwestern Missouri, and now in the collection of S. A. Miller.

ACTINOCRINUS SENECTUS, n. sp.

Plate II, Fig. 23, azygous side; Fig. 24, opposite view; Fig. 25, summit.

Species medium size. Calyx obpyramidal, truncated only the diameter of the column, transverse section subpentagonal. Radial ridges sharply angular, interradial plates convex. Diameter about one fourth more than the height, column round.

Basals form a round cup about three times as wide as high. First primary radials large, about as long as wide, three hexagonal, two heptagonal. Second primary radials rather less than half as large as the first, wider than long, hexagonal. Third primary radials smaller than the second, about twice as wide as long, pentagonal, axillary, and bear upon each upper sloping side a single secondary radial. The secondary radials are thick strong plates and stand out from the calyx. There are ten ambulacral openings to the vault. Arms unknown.

The interradial areas connect with the vault, and the plates graduate into each othor. They are not uniform, and the plates vary in the regular areas from five to seven. In one area, there is one plate followed by two, in the second range, and two in the third range, in another area, there are three plates in the second range, and above which there are three more. The azygous area is very large and contains fifteen large plates. The first one is in line with the first primary radials and somewhat smaller than either of them. It is followed by two plates in the second range, three in the third range, and five in the fourth range, above which there are four plates that may be classed in this area, though they interlock with those belonging to the vault.

The vault is depressed convex and covered with a few very large tumid plates. The central plate is large and surrounded by seven large plates. The azygous orifice is outside of the circle of seven plates. The plates over the ambulacral channels are large and those in the slightly concave interradial areas smaller.

The species is congeneric with *Actinocrinus chouteauensis*, and neither of them are typical *Actinocrinus*. The calyx is that of an *Actinocrinus*, and the vault is more like that of an *Agaricocrinus*. Under these circumstances, we think they should be referred to *Actinocrinus*, as the differences are not sufficient to cause them to be referred to a new genus. They do not belong to *Physetocrinus* evèn if that genus is worth retaining, which may be doubtful. They have no resemblance to *Amphoracrinus*, which is a genus having a quadrangular second primary radial, which allies the calyx to *Batocrinus*, and which has a ponderous high vault and large proboscis. No true *Amphoracrinus*, as represented by the type, *A. gilbertsoni*, or the allied species, *A. atlas*, has ever been found in America, and probably all American species that have been referred to *Amphoracrinus* belong to *Actinocrinus*.

Found by R. A. Blair, in the Chouteau limestone, at Sedalia, Missouri, and now in the collection of S. A. Miller.

FAMILY DOLATOCRINIDÆ.

DOLATOCRINUS NEGLECTUS, n. sp.

Plate II, Fig. 27, basal view; Fig. 28, summit; Fig. 29, side view.

Species full medium size. Calyx low, basin shaped, a little more than three times as wide as high, broadly and deeply concave below, the depression including the second radials, and having a deep funnel-shaped columnar pit which is bounded by a pentagonal rim. The angles of the pentagon unite with the radial ridges, and the funnel within the rim is smooth or without ornamentation and extends as high as the top of the calyx. Radial ridges within the concavity, angular elevations, but above, they are broken into elongated angular nodes by the sutures between the plates. The surface of the interradial areas is radiately sculptured from a central pit, instead of from a central node; and other parts of the calyx are irregularly sculptured. Column round and attached at the bottom of the funnel-shaped columnar pit.

Basals form a round cup deeply inserted in the calyx where they rise as high as the top of the calyx. The mouth of the cup is about one-third wider than the diameter of the column. First primary radials as long as wide, smooth below the pentagonal rim and sculptured above it. Second primary radials twice as wide as long, quadrangular. Third primary radials larger than the second, pentagonal axillary, and, in each of four of the rays, bears upon one upper sloping side four secondary radials, and upon the other a single secondary radial which is axillary and supports on each upper side three tertiary radials, which arrangement gives to each of these rays three arms. In the other ray, the third primary radial bears upon each upper sloping side a single secondary radial which is axillary, and one of them bears upon each upper sloping side three tertiary radials and the other bears upon one sloping side three tertiary radials and upon the other, two, the last of which is axillary and bears upon each upper side two quaternary radials, which gives to this ray five arms. There are, therefore, seventeen arms in this species. The arm formula is 3+5 3 3 3.

There seem to be only two interradials in each area. The first is medium, in size, for species, in this genus, and the second is smaller and cut off from connection with the vault by a union of the radial plates. Or, at least, we cannot find any sutures for the small plates that usually unite these areas with the vault. The azygous area is substantially like the other areas.

The vault is highly convex and bears a short subcentral proboscis. The vault is covered by a few large, plane plates. There are two elongated, curved, ovarian apertures in each interradial area, and two within each radial series which gives to this species twenty ovarian apertures.

This species most resembles *D. hammelli*, from which it is distinguished by having seventeen instead of sixteen arms. It has also an increased number of tertiary plates as well as the quaternary plates. The interradial areas are connected with the vault by two plates in that species, which do not, as it appears, exist in this species. There are other minor differences.

Found by Geo. K. Greene in the Hamilton Group near Charlestown, Indiana, and now in the collection of Wm. F. E. Gurley.

STEREOCRINUS INDIANENSIS n. sp.

Plate III, Fig. 13, view of a calyx showing all the plates; Fig. 14, lateral view, showing height of calyx; Fig. 15, view of a silicified specimen in the usual condition.

Species small. Calyx flat with the exception of raised, rounded, radial ridges. The surface of the plates is delicately sculptured.

The basal plates are small, and form a small, more or less, conical elevation in the interior. The first primary radials are about twice as large as the second. The second are axillary and support on each upper sloping side a series of secondary radials. As many as five secondary radials are preserved in some of the rays. There is no other bifurcation of a ray. There are, therefore, only ten arms in this species. The first regular interradial plate is elongated and has ten sides. It is followed by two elongated plates in the second range, beyond which we have been unable to see the sutures. In the inter-secondary areas one plate is followed by two in the second range, and those by three in the third range, beyond which silicification has destroyed the sutures in our specimens.

The vault is low, but our specimens are not preserved to throw any light upon it.

The greater number of specimens are found silicified, and it is rare to find the crinoidal structure exposed. It is a remarkable species and bears little or no resemblance to the type species. Indeed no one would suspect that they could belong to the same genus, without having compared them with the generic formula. The two primary radials in each species alone ally them with each other.

Found by Geo. K. Greene in the Hamilton Group, near Charlestown, Indiana, and now in the collection of Wm. F. E. Gurley.

FAMILY RHODOCRINIDÆ.

RHODOCRINUS DOUGLASSI, n. sp.

Plate III, Fig. 1, azygous area on the left.

Species medium or above medium size. Calyx bowl-shaped, or subcylindrical, radial ridges not defined. Plates sculptured and more or less pyramindal. Basal cavity deep. Column medium size, round, and composed of plates of equal length.

Basals form a cone, within the calyx, into which the end of the column is inserted. Subradials slightly larger than the first primary radials and sculptured pyramidal. First primary radials pyramidal, heptagonal and hexagonal. Second primary radials about one fourth as large as the first, nearly as long as wide, pentagonal. Third primary radials about the size of the second, hexagonal, and support on each of two upper sides, the secondary radials. There are three secondary radials in each series, the first one being the larger and the last one being axillary. There is a plate, resting in the angle, formed at the juction of the first secondary radials, which has the appearance of belonging to a radial series and the third plate above being axillary. But here an explanation becomes necessary. Our specimen is injured, at this place, as shown in the illustration, and we cannot determine exactly how the arms attached. The ray we are describing is on the right of the azygous area and bears seven arms. The axillary third secondary radial on the right very clearly bears two arms and the axillary third secondary radial adjoining the azygous area bears upon one side an arm and upon the other two plates, the last one being axillary and supporting two arms. It leaves, therefore, two arms to be supported by the middle series of plates. This arrangement may be peculiar to this ray. The right lateral ray is not fully exposed, as the specimen is on a slab, but it appears to have only six arms, but one appears to follow the plate resting in the angle at the junction of the first secondary radials. The species, therefore, possesses between thirty and thirty-five arms. If the rays were uniform it would possess thirty-five arms, but another specimen on the same slab shows one ray very clearly possessing only six arms. The arms are small and composed of a double series of small interlocking plates that bear strong pinnules.

In the regular interradial area, shown, in the illustration, the first plate truncates a subradial, it is followed by two plates in the second range, three in the third, and three in the fourth, above which they are not disclosed. In the azygous area the first plate is twice as large as the first plate in the regular area and truncates a very large subradial. It is followed by four plates in the form of an arch the middle one of which is as large as the first plate in a regular area. There are also four plates, in the form of an arch, in the third range, the middle one of which is the larger and above these smaller plates graduate up into the vault.

The vault is not exposed in either of our specimens.

This is a strongly characterized species.

Found by Earl Douglass, in whose honor we have proposed the specific name, in the Upper Burlington or Lower Keokuk Group, on Bridger Mountains, near Bozeman, Montana, and now in his collection.

RHODOCRINUS BOZEMANENSIS, n. sp.

Plate III, fig. 2, side view.

Species rather below medium size. Calyx bowl-shaped, radial ridges not defined. Plates sculptured and more or less pyramidal. Basal cavity deep. Column medium size, round, and composed of plates of equal length.

Basals form a cone within the calyx, into which the end of the column is inserted. Subradials not any larger than the first primary radials, and entirely within the basal concavity. First primary radials pyramidal, heptagonal and hexagonal. Second primary radials about one-third as large as the first, nearly as long as wide, pentagonal. Third primary radials about the size of the second, hexagonal, and support on each of two upper sides the secondary radials. Our specimen is slightly injured at the base of the arms, but as near as can be determined there are three secondary radials in each series, the last being axillary and supporting the arms. This gives twenty arms to the species. The arms are composed of a single series of cuneiform plates, each one of which bears a long, strong pinnule.

In the regular interradial area, shown in the illustration, the first plate is as large as a first primary radial, truncates a subradial, and is followed by two somewhat smaller plates in the second range, two quite small plates in the third range, and one or more in the fourth range. Above the fourth range the plates are not accurately determined. This is evidently a regular interradial area. The other areas and the vault are unknown.

This species will be readily distinguished from *R. douglassi* by being a smaller species, having only twenty arms instead of thirty or more, and by the single series of arm plates instead of a double series.

Found by Earl Douglass in the Upper Burlington or Lower Keokuk Group, on Bridger Mountains, near Bozeman, Montana, and now in his collection.

RHODOCRINUS BRIDGERENSIS, n. sp.

Plate III, fig. 3, side view.

Species below medium size. Calyx globular or subspheroidal. No radial ridges. Plates granular, not sculptured. Basal cavity moderately deep, column very large, composed of very short pieces. This species has twenty arms. The arms are small.

This species is distinguished by the globular calyx, large column and small arms.

Found in the Burlington or Keokuk Group by Earl Douglass, in Bridger Mountains, Montana, and now in his collection.

PLATYCRINUS BOZEMANENSIS, n. sp.

Plate III, Fig. 5. view showing the arms and calyx except a small piece which is broken off.

Species medium size and belonging to the round, bowl-shaped or goblet-shaped forms. Calyx round, bowl-shaped, constricted above the base so as to leave a flange below, and about as high as wide. Sutures distinct, surface smooth or granular. Column flattened, twisted, and composed of thick plates.

The basals form a cup, constricted above the base. First radials longer than wide, with a very slight increase in width upward. Articulating facets for the second radials occupy one half the width of the plates. Second radials very short, axillary, and bear upon each upper sloping side two secondary radials, the last being axillary and bearing, upon one side, a free arm, while the other arm bifurcates, on the second plate, which arrangement gives to each ray six arms. There are, therefore, thirty arms in this species. The arms are robust and in the lower part are composed of cuneiform plates, but above, they are composed of a double series of interlocking plates. They bear long, coarse pinnules. Vault unknown.

If we had only the calyx of this species we might be unable to distinguish it from some of the smooth, round, constricted forms, but the coarse thirty arms will serve, at all times, to distinguish it. Another specimen than the one illustrated shows the constricted basal plates.

Found by Earl Douglass, on Bridger Mountains, near Bozeman, Montana, and now in the collection of S. A. Miller.

PLATYCRINUS SHARONENSIS, n. sp.

Plate III, Fig. 6, basal view; Fig. 7, side view of basal plates.

We have a number of large basal discs of *Platycrinus*, which are too poor for proper specific definition, though we know they are undescribed. We usually think we know the column of a *Platycrinus*, by its twisted form and elliptical, transverse section, but we frequently find them larger than any described species. We have, in this instance only the basal plates, but they are so striking and extraordinary that we feel warranted, though with some hesitation, in giving them a name.

Species very large. Calyx round, bowl-shaped and broadly truncated below, evidently for a very large column. Columnar canal very large and round.

Basal plates almost equal in size, though one of them is quadrangular, which shows that we have a *Platycrinus* before us. The basal plates form an expanded basin with a broad, flat bottom. It is nearly three times as wide as high, and the flat bottom for the attachment of the column is nearly three fourths as wide as the top. It is constricted so as to form a basal rim which is nodose or notched. There are rounded nodes on either side of each suture, from the base to the top, and a few rounded nodes on other parts of the plates. Otherwise, the surface of the plates is finely granular. The ornamented basal rim would seem to be a support to the base of the calyx, but the upper part of the basal plates is thin for so large a species.

Found in the Burlington Group, near Sharon, in southwestern Missouri, by R. A. Blair, and now in the collection of S. A. Miller.

PLATYCRINUS BRIDGERENSIS, n. sp.

Plate III, Fig. 8, azygous view.

Species rather below medium size, and belonging to the pentagonal, bowl-shaped forms. Sutures not beveled. Surface finely granular. Plates thick. Column small and round.

Basals form a low cup two and a half times as wide as high and constricted above the base so as to form a basal rim.

Articulating facets for the second radials occupy one-third the width of the plates. Second radials very short, axillary, and bear upon each upper sloping side two secondary radials, the last being axillary, and bearing upon one side, a free arm, while the other arm bifurcates on the second plate, which gives six arms to each ray. There are, therefore, thirty arms in this species. The arms are slender and composed of alternating cuneiform plates, having very fine pinnules.

Found by Earl Douglass, on Bridger Mountain, near Bozeman, Montana, and now in the collection of S. A. Miller.

FAMILY DICHOCRINIDÆ.

DICHOCRINUS BOZEMANENSIS, n. sp.

Plate III, Fig. 4, azygous view of calyx and arms.

Species medium size. Calyx obconoidal, nearly as high as wide. Surface longitudinally lined or sculptured, but this feature is not shown in the illustration, because the upper surface of the calyx is worn and it would have to be supplied; some of the ornamentation only, in the lower part of the specimen is preserved. Sutures not impressed. Column small and round.

The two basals form a little cup about twice as wide as high. It is contracted above the bottom so as to leave an expanded basal rim. The first radials are a little less than twice as long as wide and very slowly increase in width to the superior end, which bears a concave facet about one-half the width of the plate for the attachment of the second radial or first brachial. Second radial short, rounded. Third radial about the size of the second, pentagonal, axillary and supports upon the upper sloping sides the free arms. The arms bifurcate on the third plate, giving four arms to each ray. There are, therefore, twenty arms in this species, provided only, that the ray opposite the azygous plate, which cannot be seen in our specimen, is like the others. The arms are long and composed of a single series of cuneiform plates, each one of which bears a long, coarse pinnule. The vault cannot be seen in our specimen.

Found in the Upper Burlington or Lower Keokuk, on Bridger Mountains, near Bozeman, Montana, by Earl Douglass, and now in his collection.

TALAROCRINUS PATEI, n. sp.

Plate III, Fig. 9, view opposite the azygous side of a large specimen; Fig. 10, azygous side of same; Fig. 11, azygous side of a small specimen, plates of the vault, though preserved, are not indicated; Fig. 12, opposite view of same.

We have ten specimens belonging to this species, the smallest of which is not half as large as the smaller one illustrated; the larger one illustrated is the largest in the collection.

General form of the calyx and vault, somewhat obovate. Calyx broadly truncated and somewhat in the form of the frustum of a cone.

Plates convex. Sutures depressed. Surface very finely granular. Column round, medium size.

Basals pentagonal and form a cup about one-fourth the height of the calyx, having a concave depression around the column, which is inserted in a hemispherical cavity. First radials large, convex, longer than wide, four of them are of about the same size and rest on straight faces of the basals; the other one is larger and rests in the obtuse angle formed at the union of the two basals. The second radials are very small, short, triangular, occupy about one-third the width of the first radials, axillary and support on each upper sloping side a single small secondary radial. The secondary radials are highly convex, axillary and support on each upper sloping side the free arms. There are, therefore, twenty arms in this species. The first arm plates are small, round and convex. Whether the arms bifurcate after becoming free is unknown. The convexity of the first radials leaves the small second radials resting on the inner margin, which produces an apparent constriction of the calyx at the top of the first radials.

The first azygous plate is in line with the first radials and is longer than either of them. The superior end appears to curve over upon the vault.

The vault is not large, somewhat pyramidal by reason of the interradial depressions, and covered with nodose and spinous plates.

This species is so readily distinguished from *T. trijugis* and *T. cornigerus*, its nearest allies, that no comparison is necessary.

Found by W. F. Pate, a collector and Principal of the Lebanon schools of Kentucky, in whose honor we have proposed the specific name, in the Kaskaskia Group, in Breckenridge county, Kentucky, and now in the collection of Wm. F. E. Gurley.

CLASS STELLERIDA.

ORDER ASTEROIDEA.

FAMILY PALÆASTERIDÆ.

PALÆASTER WYKOFFI, n. sp.

Plate III, Fig. 27, ventral side.

Species medium size. Rays petaliform; length about one and a half times the diameter of the body; breadth of a ray at the place of junction with the body, about two-thirds the diameter of the body; obtusely pointed.

Marginal plates wider than long and numbering about fifteen in the length of half an inch from the body. The marginal plates curve regularly around the tips of the rays. The adambulacral range curves around the ends of the rays within the marginal plates and consists of subquadrate plates, wider than long. They are a little shorter than the marginal plates, so that there are about eighteen in the length of half an inch. There are ten oral plates at the junction of the adambulacral rows which present triangular extensions toward the center of the ventral cavity. A single, irregular, axillary plate rests between the terminal marginal plates and the angle formed at the junction of the adambulacral plates. The ambulacral plates have their greatest length across the rays, thus providing a wide ambulacral furrow. Each plate is furnished with a sharp ridge in the middle, extending from the middle furrow to the adambulacral plates.

Our specimen exposes only the ventral side and no spines are preserved. It is a well-marked and beautiful species.

Found in the upper part of the Hudson River Group, near Madison, Indiana, by Chas. W. Wykoff, in whose honor we have proposed the specific name, and now in the collection of Wm. F. E. Gurley.

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Plate II, Fig. 30, summit; Fig. 31, side view; Fig. 32, under side.

This is a spheroidal bulb, composed of nodose, sculptured plates. The sculpturing makes them pyramidal, and, on the under side, there is a pit at each angle, which may penetrate the bulb. The plates are larger on the upper side than they are below. The lower side may have attached to some other object at the large circular aperture. If it ever attached to a crinoid, as part of the proboscis, we have no idea how it attached or to what genus or species it belonged. When a proboscis is prolonged or balloon-shaped, the orifice is at or near the summit. This has no orifice on top. We have occasionally seen crinoidal matter that did not seem to belong to any of the established orders, and *quære*, have we such a specimen here. We are free to say, we do not know where it belongs and, therefore, do not name it; but illustrate it to call special attention to it, beside we have only the specimen illustrated.

Found by R. A. Blair in the Burlington Group, at Sedalia, Missouri, and now in the collection of S. A. Miller.

CLASS BRACHIOPODA.

ORDER LYOPOMATA.

FAMILY CRANIIDÆ.

CRANIA CHESTERENSIS, n. sp.

Plate III. Fig. 24, specimen on the fenestrated portion of a bryozoan; Fig. 25, two specimens on bryozoan; Fig. 26, specimen on a shell.

Shell rather below medium size or about as large as *Crania scabiosa*, from the Hudson River Group, and very much like it in general appearance.

It is thin, discoid and subcircular in outline. The dorsal valve appears as if collapsed, or depressed in the visceral area, so as to leave an elevated rim just within the margin. The margin outside of the middle of the elevated rim is marked with lamellose lines of growth and sometimes one or two lamellose lines of growth may be detected within this elevated border, but generally the surface is smooth. There are no radiating lines. The apex of the dorsal valve consists of a smooth, obtusely pointed, subcentral elevation that rises about one-half higher than the elevated border. The ventral valve is unknown.

This species is found attached to the hardened borders and sometimes to the fenestrated expansions of *Lyropora lyra*, Hall, of which *Lyropora ranosculum*, Ulrich, is a synonym, *Lyropora subquadrans*, Hall, and *Lyropora quincuncialis*, Hall, of which *Lyropora divergens*, Ulrich, is a synonym. It is also found attached to the valves of *Sperifera* and probably to other foreign objects. When it is attached to the fenestrated expansions of *Lyropora* the fenestrules are indicated in the dorsal valve. It is gregarious.

Found in the Kaskaskia Group at Chester, Illinois, and now in the collection of Wm. F. E. Gurley.

FAMILY PHOLADOPIDÆ.

PHOLIDOPS GREENEI. n. sp.

Plate III, Fig. 16, dorsal view; Fig. 17, interior of same; Fig. 18, profile view; Figs. 19, 20 and 21, the same enlarged twice natural size.

This is a small species, collected by G. K. Greene in the washings of the debris from the Hamilton Group, near Charlestown, Ind. In general form it resembles *Pholidops cincinnatiensis* from the Hudson River Group, but this resemblance is only in the dorsal valve, for *P. cincinnatiensis* has a flat ventral valve, and a foramen at the beak, that are not possessed by this species. This species possesses the characters of the Devonian forms described by Prof. Hall from New York, but minute comparisons are unnecessary. It is sufficient to say that it is a well-marked and distinct species.

It is in the collection of S. A. Miller.

CLASS GASTROPODA.

FAMILY CALYPTRÆIDÆ.

PLATYCERAS INDIANENSE n. sp.

Plate IV, Fig. 7, lateral view of the small specimen; Fig. 8, dorsal view; Fig. 9, aperture; Fig. 10, side view of a mature shell with part of the side and sinuated end broken away.

Species rather large. The back of the body whorl, from the apex to the aperture, is sharply angular and strongly serrated. Toward the apex the shell is laterally compressed, but it expands laterally toward the aperture. The apex is sharply pointed. The shell makes about one volution, in nearly the same plane, when the apex comes in contact with the rapidly spreading body whorl.

The aperture is compressed subelliptical, in outline, in the specimen illustrated, by fig. 9, with a moderately deep sinus at the angular back of the body whorl. And the shell substance is thin, which indicates, probably, a young shell, or, it may be, the apical end of a mature specimen.

Fig. 10 represents a mature specimen. It is much extended upon the back of the body whorl and the shell gradually becomes thicker, but the aperture below the beak remains in the same position that it is in in the specimen shown in fig. 8. The aperture increases its length, and by reason of the lateral expansion of the shell with the growth, it retains a compressed subelliptical outline, but acquires a deep sharply angular sinus at the back of the shell.

The surface is marked by concentric undulating striæ, that become more and more pronounced toward the aperture. They are not shown in the illustrations.

This species is distinguished by the compressed angular serrated back of the shell, and by the compressed, subelliptical aperture having a deep, angular sinus.

Platyceras thetis var. subspinosum, as illustrated in Pal. N. Y., Vol. V, part 2, Plate III, fig. 30; has a continuation of the shell, showing the older growth, similar to that preserved in our specimens of this species, but the growth is not wholly upon the back of the shell as it appears to be in this species. There is a great difference in the growth of the shell, below the apex, in different species, and in all species the apertures must change more or less with the growth of the shell.

Found by G. K. Greene near Charlestown, Indiana, in the Hamilton Group, and now in the collection of Wm. F. E. Gurley.

CLASS CEPHALOPODA.

SUBCLASS TETRABRANCHIATA.

ORDER NAUTILOIDEA.

FAMILY MELONOCERATIDÆ.

REMELECERAS CLARKENSE n. sp.

Plate IV, Fig. 1, lateral view; Fig. 2, dorsal view; Fig. 3, ventral view of the same fragment.

Prof. Hyatt founded the genus *Remeleceras*, dedicated to Remele, an author on Cephalopods, in 1894, in the Proceedings of the American Philosophical Society, Vol. XXXII, p. 525. The genus was founded on a fragment of a cast from an unknown locality and named *R. impressum*. If we are correct in referring our species to his genus, it will serve to fix the geological range of his species and possibly point toward the locality. Our specimen is from what is called by the local collectors, in Indiana, the Knobstone Group, which is not very definite, but means the Keokuk Group and the Waverly, where the two are not separable, and the fossils are generally casts.

Our species is larger than the type. Volutions numerous. Umbilicus wide and showing almost completely each inner turn, and probably perforated. The rapid enlargement of the part preserved indicates a complete perforation. Transverse section subelliptical. The ends in fig. 2 are altogether too round, a better idea of the subelliptical section will be formed by comparing figs. 1 and 2 or figs. 2 and 3. It is the way the ends are fractured that gives this erroneous outline in fig. 2, drawn under a camera lucida. The ventral side is depressed convex, with a subangular ventro-lateral ridge on each side. Lateral sides narrowly rounded toward the umbilicus. Dorsal side has a slightly concave depression or contact furrow, a little less than one-third the lateral diameter of the shell. The sutures have broad ventral and lateral lobes with saddles ventro-laterally and at the commencement of the umbilicus, or they might be said to be indicated by a waving line. Each one forms, however, a V-shaped angle in the dorsal sinus or contact furrow. The septa are distant on the ventral side, about one-half the dorso-ventral diameter. At the small end of our specimen they are distant a little less than half the dorso-ventral diameter and at the larger end a little more than half the dorso-ventral diameter. The outer shell is unknown.

Found by G. K. Greene, in the Knobstone Group, at Sampson Springs, in Clarke county, Indiana, and now in the collection of Wm. F. E. Gurley.

FAMILY NAUTILIDÆ.

SOLENOCHILUS HENRYVILLENSE, n. sp.

Plate IV, Fig. 4, lateral view; Fig. 5, dorsal view and transverse section, the black spot may not be the siphuncle; Fig. 6, ventral view.

Species medium size, judging from our incomplete specimen. Shell subglobose. Whorls expand laterally much more rapidly than they do dorso-ventrally. Umbilicus small, deep, perforated. Margin of the umbilicus abruptly rounded. Our specimen preserves two volutions, but a complete shell may have three or more. The volutions are deeply embracing, showing only a small margin in the umbilicus. In the early growth of the shell, a transverse section, disregarding the dorsal sinus is subquadrangular, but later, a transverse section becomes subovate. The lateral surfaces are flattened, and converge toward the ventral side. The ventral side is, in early life, depressed convex, but later, becomes sharply rounded. Septa only moderately concave, and increase their distance apart with the growth of the shell; but not so rapidly as the shell expands. The sutures have broad ventral and lateral lobes with saddles at the ventro-lateral and dorso-lateral angles.

A little of the outer shell is preserved on our specimen and it is thin, but no surface ornamentation is preserved. The living chamber is unknown. What appears to be the siphuncle is on the ventral side of the center, and our specimen has two chambers broken so as to show smooth septa, at the ventral margin, without any evidence of a siphuncle near the ventral margin, where it usually occurs in this genus.

This species is so different from *S. collectum*, which it may be said to most resemble, that a comparison is unnecessary to distinguish it.

Found by G. K. Greene, in the Knobstone Group, near Henryville, Indiana, and now in the collection of Wm. F. E. Gurley.

TEMNOCHILUS GREENENSE, n. sp.

Plate V, Fig. 3, lateral view, the body chamber and part of the air chambers not preserved. A transverse section being trapezoidal in outline, the dotted line in the figure in the text should be contracted.

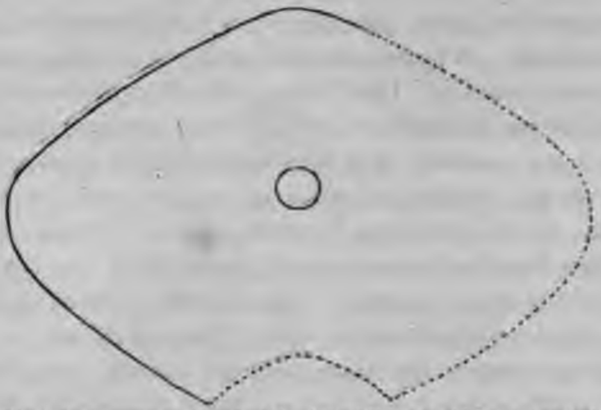

Fig. 1, transverse section, but the dotted line should be contracted to a trapezoidal outline.

Species very large, subdiscoidal, and consisting of five or more volutions, though our specimen, being imperfect, shows less than four. Umbilicus very wide, perforated and discloses about four-fifths of the dorso-ventral diameter of each inner turn. Transverse section subtrapezoidal. Our specimen is injured upon one side, and hence a correct transverse section could not be taken from it; it is clear, however, that the sides are not equal, that a section is subtrapezoidal, and that the dotted line drawn by the artist, in the figure, should be considerably contracted. The lateral diameter is near one third greater than the dorso-ventral. The ventral side is highly convex and subangular subcentrally, the lateral sides are more highly convex, subangular, and bear on the angular ridge a few very large obtuse nodes, about ten or twelve nodes on each whorl. The contact furrow is not disclosed in our specimen. The sutures are direct on the umbilical side, but form broad saddles over the angles with shallow intervening lobes. The septa are distant, on the ventral side, about one-third the dorso-ventral diameter.

The siphuncle is small, only slightly expanded within the air chambers, and situated on the ventral side of the center or between the subangular ridges on the lateral sides. Outer shell and living chamber unknown.

This species bears some resemblance to *T. coxanum*, but that is a small species, depressed convex on the ventral side, which alone is sufficient to distinguish it. Indeed there may be some doubt about this species being a true *Temnochilus*, but it seems, at least, to be nearer related to that genus than to any other.

Found in the Kaskaskia Group, on Fish Creek, in Greene county, Indiana, and now in the collection of Wm. F. E. Gurley.

SUBKINGDOM CŒLENTERATA.

CLASS ANTHOZOA.

SUBCLASS ZOANTHARIA.

FAMILY CYATHOPHYLLIDÆ.

AMPLEXUS (?) ROCKFORDENSIS, n. sp.

Plate III, Fig. 22, side view; Fig. 23, transverse section.

Corallum medium size, simple, elongate, somewhat obconoidal, more or less twisted or curved. Epithecal crust very strongly developed, entirely covering the septa, and bearing numerous spines irregularly scattered over the whole surface.

A transverse section shows twenty-eight septa that reach about one-third of the way to the center.

Our specimen does not show the calyx, and we have no knowledge of the tabulæ except the transverse section shows a solid center in the corallum. The constrictions, if any exist, are covered by the epitheca.

We are not certain that this species belongs to Amplexus, but it is certainly a Cyathophylloid coral, and the solid center indicates an Amplexus; but if there are no constrictions it belongs elsewhere.

The remarkably thick, wrinkled, and spine-bearing epithecal crust will serve to distinguish it until more is known of the internal structure.

Found in the Kinkerhook Group, at Rockford, Indiana, and now in the collection of Wm. F. E. Gurley.

VEGETABLE KINGDOM.

CLASS FUCOIDES.

RUSOPHYCUS CHESTERENSE, n. sp.

Plate V, Fig. 1, showing three specimens on a slab.

This plant as it appears upon the slabs consists of elongated subcylindrical stems somewhat flattened upon the upper side, and having a longitudinal central depression, from which rounded ribs are directed diagonally at either side. The diameter of a stem is about half an inch, and there are about 10 rounded ribs on either side of the depression in the distance of an inch.

Found in the Kaskaskia Group, at Chester, Ill., and now in the collection of Wm. F. E. Gurley.

RUSOPHYCUS MONTANENSE, n. sp.

Plate V, Fig. 2, showing a specimen on a slab.

This plant as it appears upon the slabs consists of simple elongated subcylindrical stems, somewhat flattened upon the upper side, and having a longitudinal central depression from which rounded ribs are directed diagonally at either side. The diameter of a stem is a little more than half an inch, and there are about 3 rounded ribs on either side in the distance of half an inch. Our two specimens of this species are a little larger than any of our specimens of *R. chesterense,* and the diagonal ribs are less numerous. These characters are shown in the illustrations which fully represent both species. Of course these differences might be regarded as only of varietal value, but as the fossils are from different Groups of rocks and therefore widely separated in geological time, we prefer to distinguish them as species.

Found in the Burlington Group, in Bridger Mountains, Montana, by Earl Douglass, and now in the collection of S. A. Miller.

SPECIAL REMARKS.

After having examined numerous specimens of *Actinocrinus gibsoni* we are able to say that it is a true *Actinocrinus* with no near affinity to an *Eretmocrinus* or any species of *Batocrinus*.

In describing *Goniasteroidocrinus lyonanus* it was suggested that the functions performed by the lateral prolongations from the vault the "pseudo-ambulacral appendages" of Meek, might not be essentially distinct from those performed by the proboscis in other genera. This view we have not entertained since the study of the genus *Dolatocrinus*, as may be seen from our remarks under that genus, and also under *Batocrinus*, and under the definitions of *Gilbertsocrinus greenei* and *Goniasteroidocrinus faberi*. We now regard them as ovarian extensions. If the pores, which we have called ovarian, are really ovarian pores, there would be little doubt about these extensions from the vault belonging to the ovarian system. The great difficulty, that surrounds the assertion that they are ovarian, is the fact that some species do not have any visible pores. The proboscis in *Poteriocrinus circumtextus* is full of pores, and we have seen them in the proboscis of other species. Where the pores are, in the vault, between the arms, as in *Batocrinus*, we have not seen them penetrating the proboscis. All of which tends to show that the pores, at the margin of the calyx, at the bases of the arms and penetrating the proboscis performed similar functions, and if one is ovarian all are. If all this is a correct interpretation of the function of these orifices, it leads to the conclusion that genera, having pores at the angles of the plates of the calyx and not elsewhere, were in possession of ovarian pores that discharged through the calyx itself.

Batocrinus nodosarius occurs at Sedalia, Missouri, and also in Adams county, Illinois.

BRIEF RESUME.

In the ten Bulletins of the Illinois State Museum of Natural History, commencing with the third and ending with the present one, the authors have defined, from the palaeozoic rocks of Illinois, and adjacent states, one new Order, the Conularida, five new families, Enchostomidæ, Mitrocrinidæ, Pleurocystidæ, Porocrinidæ and Thalamocrinidæ, and ten new genera, Aesiocystites, Belemnocystites, Blairella, Emperocrinus, Enchostoma, Indianocrinus, Mitrocrinus, Sampsonocrinus, Shumardocrinus and Thalamocrinus.

We have described and illustrated more than four hundred new species of fossils, nearly all of which belong to the Echinodermata. Beside, we have redescribed and illustrated several species of other authors which had been imperfectly described or not illustrated. While doing this work, covering a period of nearly four years, we have had the opportunity of examining the principal collections to be found in these states, and we have, as we think, discovered many things relating to the structure of crinoids that were before unknown. The work must, however, speak for itself, as to our definition of the anatomical parts, and the supposed biological functions performed by them, and the supposed place in the scale of nature to which we have referred the animals.

ERRATA.

Some of the typographical errors, which may be found in the Bulletins, have been corrected with pen and ink, in part of the editions, before distribution, others have not been. The following corrections should be made:

Bulletin No. 3, p. 14, 6th line from the top, read radial for "radical." Page 17, read Eretmocrinus cassedayanus for "Eretmocrinus lyonanus." Page 18, read A. Cassaday for Sidney S. Lyon, and opposite plate III. read Eretmocrinus cassedayanus for "Eretmocrinus lyonanus." Page 47, read Taxocrinidæ for "Taxicrinidæ." Opposite plate VII, read Campophyllum kansasense for Campophyllum "kansasenis."

Bulletin No. 5, p. 9, 2d line from top for "*Steleocystites*" read *Ateleocystites* and in the third line read *wetherbyi*. Pages 8 and 18, read *kustis* for "*Kustis*." Page 22, read *M. wetherbyi*.

Bulletin No. 6, p. 35, 20th line from top, for present read prevent. Page 39, in the last line, for "apertures" read aperture. Page 50, 9th line from the top, read truncates for "truncated." Page 52, 12th line from the top, for "cinque Foil', read cinquefoil. Opposite plate III, read tugurium for "turguium."

Bulletin No. 7, p. 13, read sampsoni for "Sampsoni" in two places. Page 47, 12th line from the bottom, read, not the light, for "that of light," and insert the word "for" between "not" and "the," in the 10th line from the bottom, and, on same page, read chouteauensis for "Chouteauensis." Page 83, read *krinon* for "*Krimon*." Page 89, 12th line from the bottom, read or, for "as."

Bulletin No. 8, p. 6, 15th line from the bottom, and in the last line, read *sinuosus* for "*sinnosus*." Page 8, 17th line from the top, read *laetus* for "*lactus*." Page 38, 20th line from the top, read there for "then." Page 64, read *siluricus* instead of "*Siluricus*." Opposite plates I and II read jessieæ for "jessiæ."

Bulletin No. 9, p. 9, read stelliformis instead of "stelliformuis," Page 15, read nitens for "niteus." Page 23, in the first line of the last paragraph, read furnishes for "furnished." Page 26, read pollubrum instead of "pallubrum." Page 36, 7th line from the bottom, read slowly for "showing." Opposite plate I, read pollubrum instead of "pallubrum," and nitens instead of "niteus." Opposite plate II, spurius instead of "spurious."

Bulletin No. 10, p. 27, read complanatus instead of "complanutus." Page 46, 2d line from the bottom, read constricted, instead of "constructed." Page 59, 1st line, in the 3d paragraph, read seven instead of "seventeen." Page 64, 7th line from the top, read *cognatus* instead of "Cognatus." Opposite plate I, read complanatus for "complanutus."

Bulletin No. 11, p. 6, Lunulicardium grande is from the Chouteau limestone, at Sedalia, Mo., instead of the Ham. Gr. at Providence. Page 6, 6th line from the bottom, read valves for "values." Page 8, last line but one in the 1st paragraph, read fine for "five." Page 15, 6th line in 2d paragraph, read lunule for "lunnule." Page 20, 9th line from the bottom, read fine for "five." Page 24, 13th line from the top, insert after the word "inches," on one side an inch. And make the rest of the sentence read "and on the other one and two-tenths inches." Page 27, last line in the 1st paragraph, read inch for "arch." Page 29, 3d line from the bottom read *Hyolithidæ* for "*Hyolithadæ*." Page 30, read specific name dunleithense for "dunleithensis." Page 31, read specific name caldwelli for "caldwellensis." Page 33, 2d line from the bottom, read recurving for "recurring." Page 41, 4th line from the top, read outer for "other," and in the 14th line insert between "authors" and "in" the words, referred to. Page 43, 5th line from the bottom, read umbilicus for "ambilicus." Page 44, 8th line from the top, read at for "as." Page 47, 3d and 4th lines in 3d paragraph, read ectorhin and endorhin for "ectorhim" and "endorhim." Page 49, 2d line in 3d paragraph, read wildly for "widely." Page 50, 1st line, read overlooked for "overlook." Opposite plate I, read Edmondia for "Edmundia." Opposite plate 3, read dunleithense for "dunleithensis." Opposite plate 4, read caldwelli, jerseyense and blairi for "caldwellensis," "jerseyensis," and "blari."

We have not undertaken to correct the typographical errors in spelling ordinary English words, or in using the singular or plural, where the errors are manifest to an intelligent reader, but have noticed the errors in spelling technical words. omissions and where the correct word might be left in doubt.

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PLATE I.

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Fig. 1. Basal view.
Fig. 2. Summit.
Fig. 3. Azygous view.

AGARICOCRINUS KEOKUKENSIS, n. sp. 7

Fig. 4. Basal view.
Fig. 5. Summit.
Fig. 6. Azygous view.

BATOCRINUS SHARONENSIS, n. sp. 18

Fig. 7. Azygous view.
Fig. 8. Opposite side of same.
Fig. 9. Lateral view.

BATOCRINUS SCITULUS, n. sp. 19

Fig. 10. Azygous view.
Fig. 11. Opposite side of same.

BATOCRINUS SENEX, n. sp. 21

Fig. 12. Azygous view.
Fig. 13. Opposite side of same.
Fig. 14. Summit of another specimen.

BATOCRINUS RELIQUUS, n. sp. 22

Fig. 15. Basal view.
Fig. 16. Azygous view.
Fig. 17. Summit.

BATOCRINUS RUSTICELLUS, n. sp. 23

Fig. 18. Basal view.
Fig. 19. Same, magnified two diameters.
Fig. 20. Azygous view.
Fig. 21. Summit.

BATOCRINUS RESERVATUS, n. sp 25

Fig. 22. Basal view, magnified two diameters.
Fig. 23. Same, natural size.
Fig. 24. Azygous view.
Fig. 25. Summit.

BATOCRINUS ROTULIFORMIS, n. sp. 26

Fig. 26. Basal veiw, magnified two diameters,
Fig. 27. Same, natural size.

PLATE I.

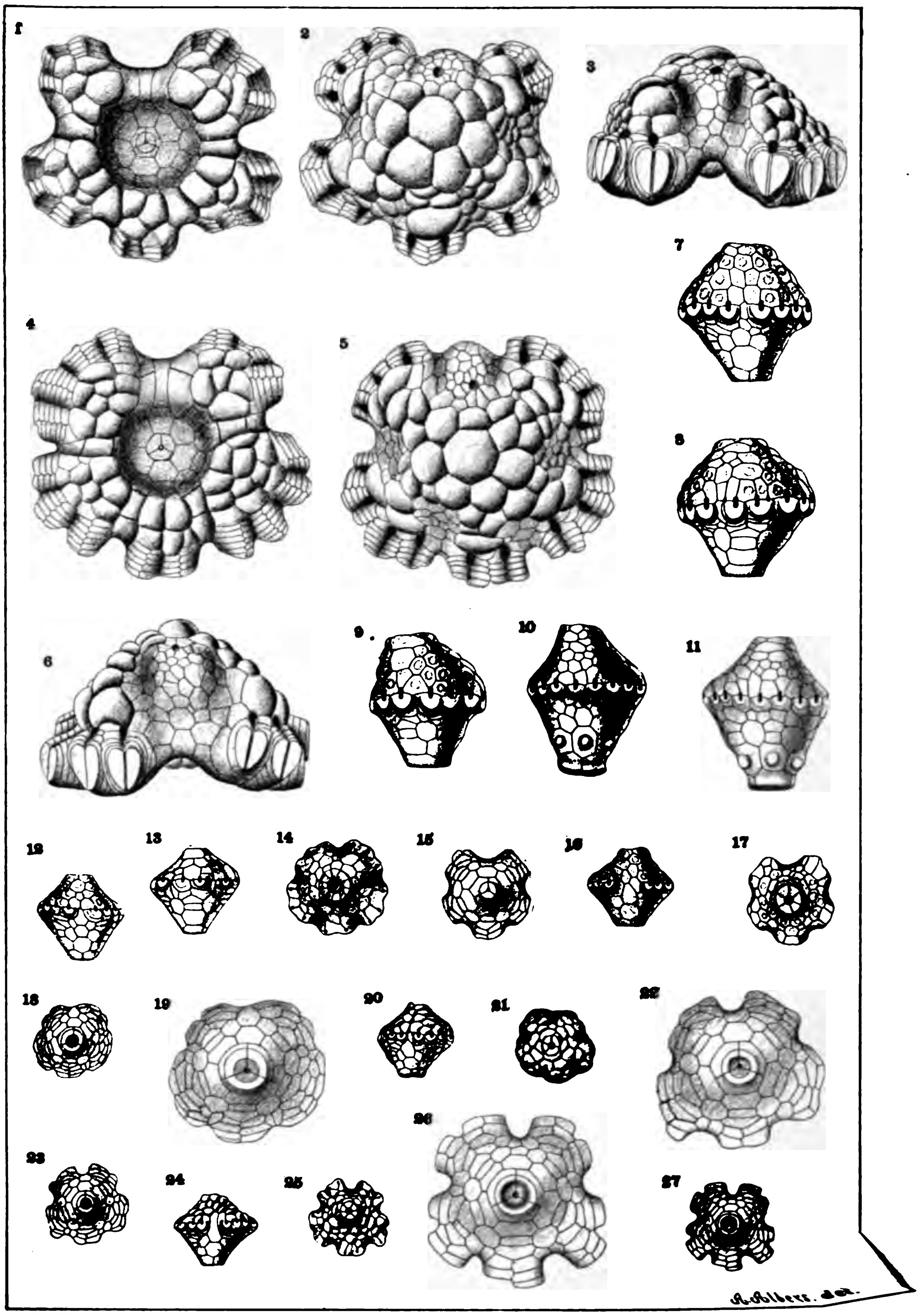

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PLATE II.

Page.

Batocrinus botuliformis, n. sp. 26

Fig. 1. Azygous view.
Fig. 2. Summit.

Batocrinus (?) rusticus, n. sp 28

Fig. 3. Basal view, magnified two diameters.
Fig. 4. Same, natural size.
Fig. 5. Azygous view.
Fig. 6. Summit.

Dorycrinus suboviformis, n. sp. 30

Fig. 7. Azygous view.
Fig. 8. Opposite side of same.
Fig. 9. Summit.

Steganocrinus sharonensis, n. sp 32

Fig. 10. Azygous view.
Fig. 11. Opposite side of same.
Fig. 12. Summit.

Steganocrinus albersi, n. sp. 33

Fig. 13. Azygous view.
Fig. 14. Opposite side of same.
Fig. 15. Summit.
Fig. 16. Basal view.

Steganocrinus griffithi, n. sp 34

Fig. 17. Azygous view.
Fig. 18. Opposite side of same.
Fig. 19. Basal view.
Fig. 20. Sumit.

Steganocrinus blairi, n. sp 35

Fig. 21. View opposite azygous side.
Fig. 22. Basal view.

Actinocrinus senectus, n. sp. 36

Fig. 23. Azygous view.
Fig. 24. Opposite side of same.
Fig. 25. Summit.

Batocrinus douglassi, n. sp. 29

Fig. 26. View opposite azygous side.

Dolatocrinus neglectus, n. sp. 37

Fig. 27. Basal view.
Fig. 28. Summit.
Fig. 29. Lateral view.

? ?. 46

Fig. 30. Summit (?).
Fig. 31. Lateral (?).
Fig. 32. Under side (?).

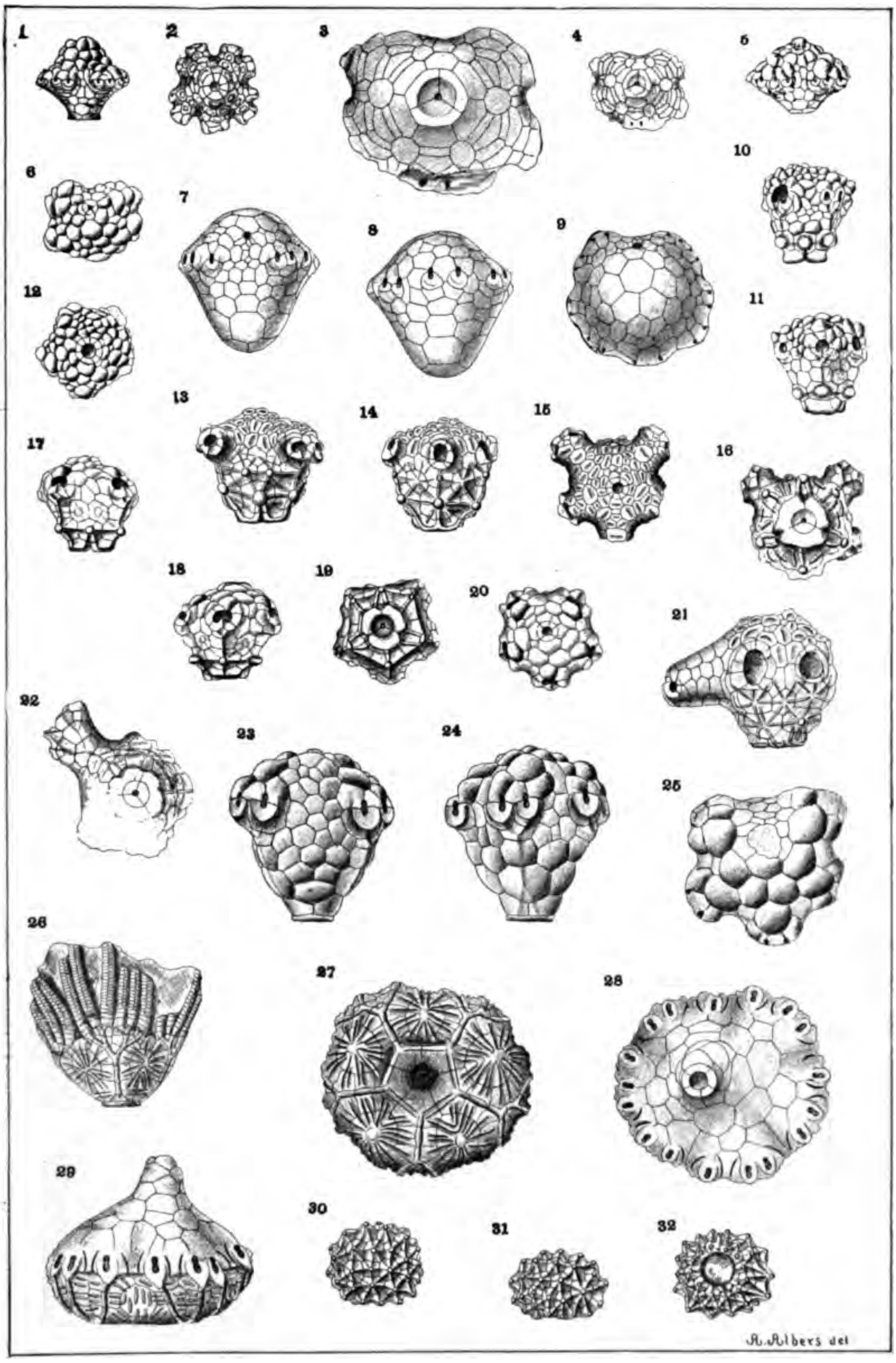
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PLATE III.

PAGE.

Rhodocrinus douglassi, n. sp. 39

Fig. 1. Azygous area on the left.

Rhodocrinus bozemanensis, n. sp 40

Fig. 2. Lateral view.

Rhodocrinus bridgerensis, n. sp. 41

Fig. 3. Lateral view.

Dichocrinus bozemanensis, n. sp 44

Fig. 4. Azygous view.

Platycrinus bozemanensis, n. sp 42

Fig. 5. Lateral view.

Platycrinus sharonensis, n. sp 42

Fig. 6. Basal view.
Fig. 7. Lateral view of basal plates.

Platycrinus bridgerensis, n. sp 43

Fig. 8. Azygous view.

Talarocrinus patei, n. sp 44

Fig. 9. View opposite azygous area.
Fig. 10. Azygous view of same.
Fig. 11. Azygous view of a smaller specimen.
Fig. 12. Opposite side of same.

Stereocrinus indianensis, n. sp 38

Fig. 13. Basal view of calyx, showing all the plates.
Fig. 14. Lateral view.
Fig. 15. Basal view of another specimen.

Pholidops greenei, n. sp 48

Fig. 16. Dorsal view.
Fig. 17. Ventral view.
Fig. 18. Profile view.
Fig. 19, 20, 21. Same magnified two diameters.

Amplexus rockfordense, n. sp 53

Fig. 22. Lateral view.
Fig. 23. End view.

Crania chesterensis, n. sp 47

Figs. 24, 25. View of specimens attached to bryozoans.
Fig. 26. View of a specimen attached to a shell.

Palaeaster wykoffi, n. sp 46

Fig. 27. View of ventral side:

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BULLETIN NO. 12. PLATE III.

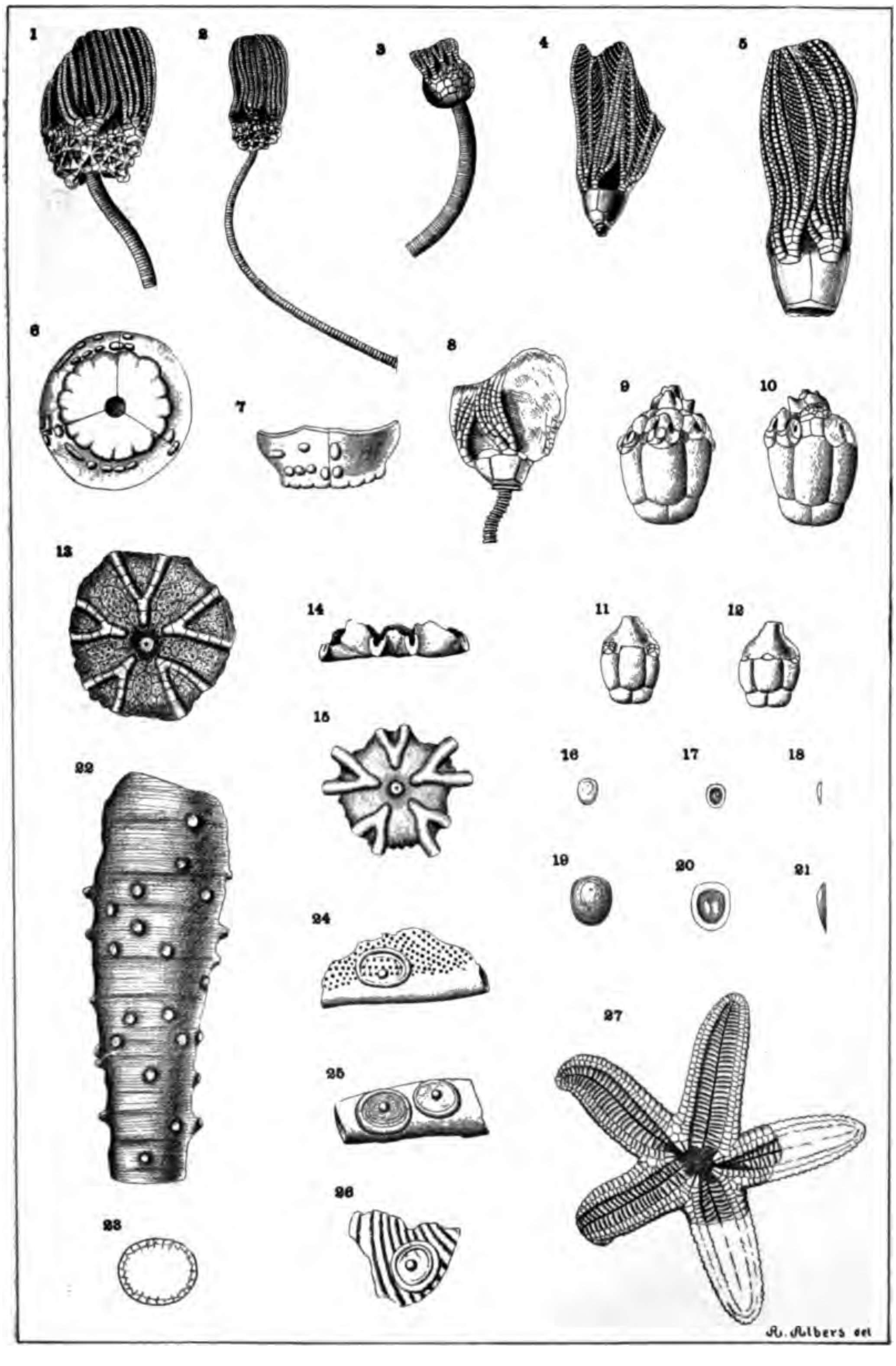

PLATE IV.

PAGE.

REMELOCERAS CLARKENSE, n. sp. 49
    Fig. 1. Lateral view.
    Fig. 2. Dorsal view.
    Fig. 3. Ventral view.

SOLENOCHILUS HENRYVILLENSE, n. sp. 51
    Fig. 4. Lateral view.
    Fig. 5. Dorsal view.
    Fig. 6. Ventral view.

PLATYCERAS INDIANENSE, n. sp. 48
    Fig. 7. Lateral view of a small specimen.
    Fig. 8. Dorsal view of same.
    Fig. 9. Aperture of same.
    Fig. 10. Lateral view of a larger specimen.

PLATE IV.

PAGE.

REMELOCERAS CLARKENSE, n. sp. 49
Fig. 1. Lateral view.
Fig. 2. Dorsal view.
Fig. 3. Ventral view.

SOLENOCHILUS HENRYVILLENSE, n. sp. 51
Fig. 4. Lateral view.
Fig. 5. Dorsal view.
Fig. 6. Ventral view.

PLATYCERAS INDIANENSE, n. sp. 48
Fig. 7. Lateral view of a small specimen.
Fig. 8. Dorsal view of same.
Fig. 9. Aperture of same.
Fig. 10. Lateral view of a larger specimen.

PLATE IV.

PAGE.

REMELOCERAS CLARKENSE, n. sp. 49

Fig. 1. Lateral view.
Fig. 2. Dorsal view.
Fig. 3. Ventral view.

SOLENOCHILUS HENRYVILLENSE, n. sp. 51

Fig. 4. Lateral view.
Fig. 5. Dorsal view.
Fig. 6. Ventral view.

PLATYCERAS INDIANENSE, n. sp. 48

Fig. 7. Lateral view of a small specimen.
Fig. 8. Dorsal view of same.
Fig. 9. Aperture of same.
Fig. 10. Lateral view of a larger specimen.

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BULLETIN NO. 12. PLATE IV.

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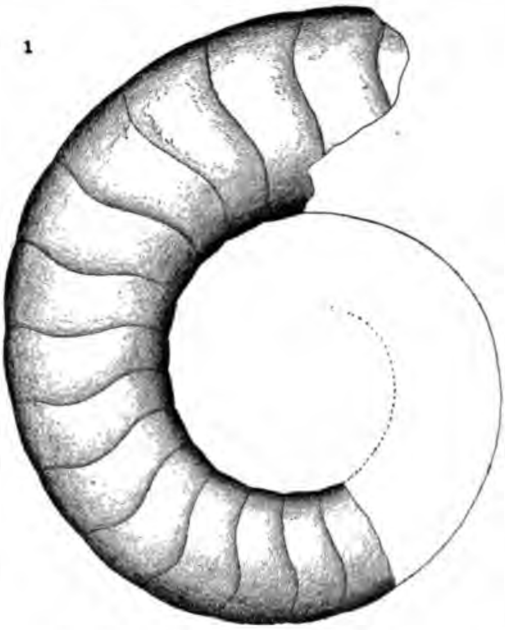

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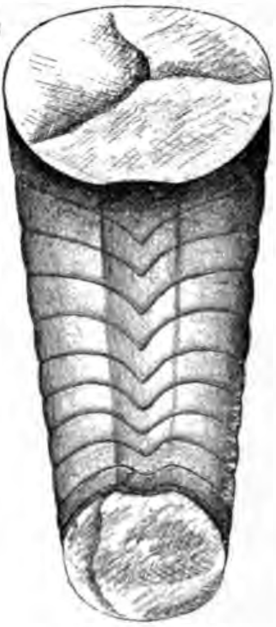

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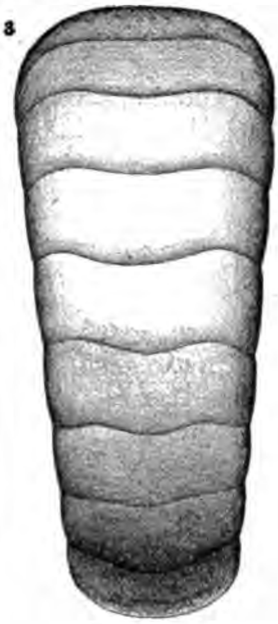

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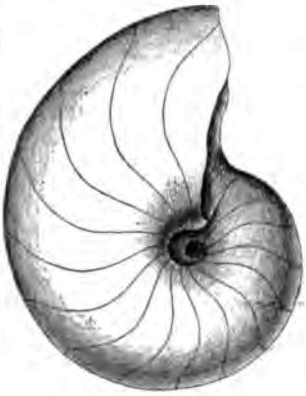

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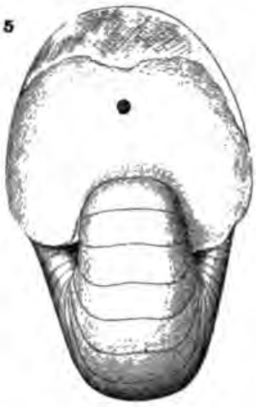

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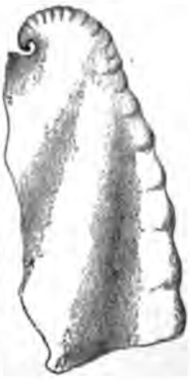

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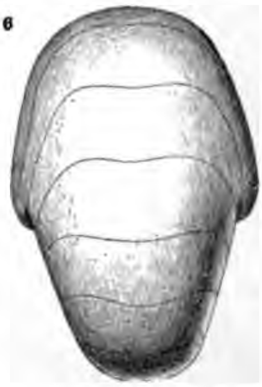

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PLATE V.

	Page.
Rusophycus chesterensis, n. sp.	54
Fig. 1. Three specimens on a slab.	
Rusophycus montanensis, n. sp.	54
Fig. 2. A specimen on a slab.	
Temnochilus greenense, n. sp.	52
Fig. 3. Lateral view.	

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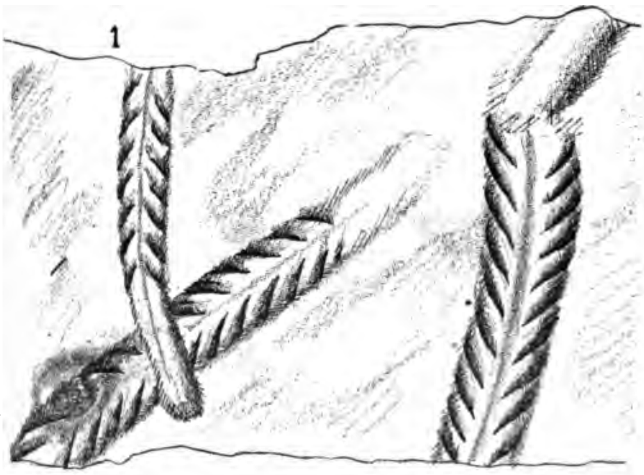

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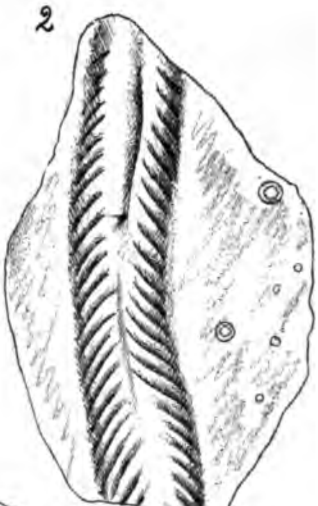

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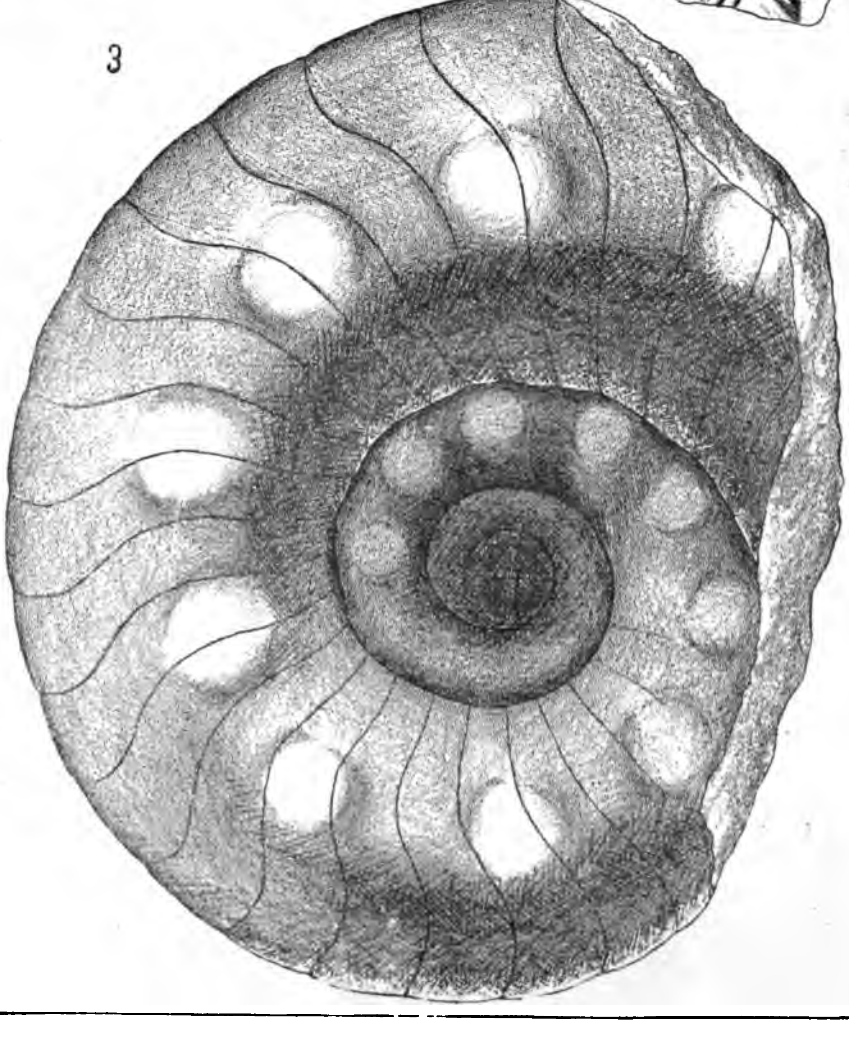

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